BELL TELEPHONE MAGAZINE

VOL. XX NOVEMBER, 1941 NO. 4

TELEPHONES AND DEFENSE

I. AN OPERATING TELEPHONE COMPANY'S PART IN NATIONAL DEFENSE

II. PROVIDING SUBSTITUTES FOR "CRITICAL" TELEPHONE MATERIALS

III. THE PRESENT SITUATION AND THE PRESENT OUTLOOK

ENGINEERING THE TRANSCONTINENTAL TELEPHONE CABLE

THE 1941 CONVERTIBLE BOND ISSUE

THE TELEPHONE AFLOAT

PATENTS AND FREE ENTERPRISE

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BELL TELEPHONE MAGAZINE

Continuing the BELL TELEPHONE QUARTERLY

A Medium of Suggestion and a Record of Progress

"The ideal and aim of the American Telephone and Telegraph Company and its Associated Companies is a telephone service for the nation, free, so far as humanly possible, from imperfections, errors, or delays, and enabling anyone anywhere to pick up a telephone and talk to anyone else anywhere else, clearly, quickly and at a reasonable cost."

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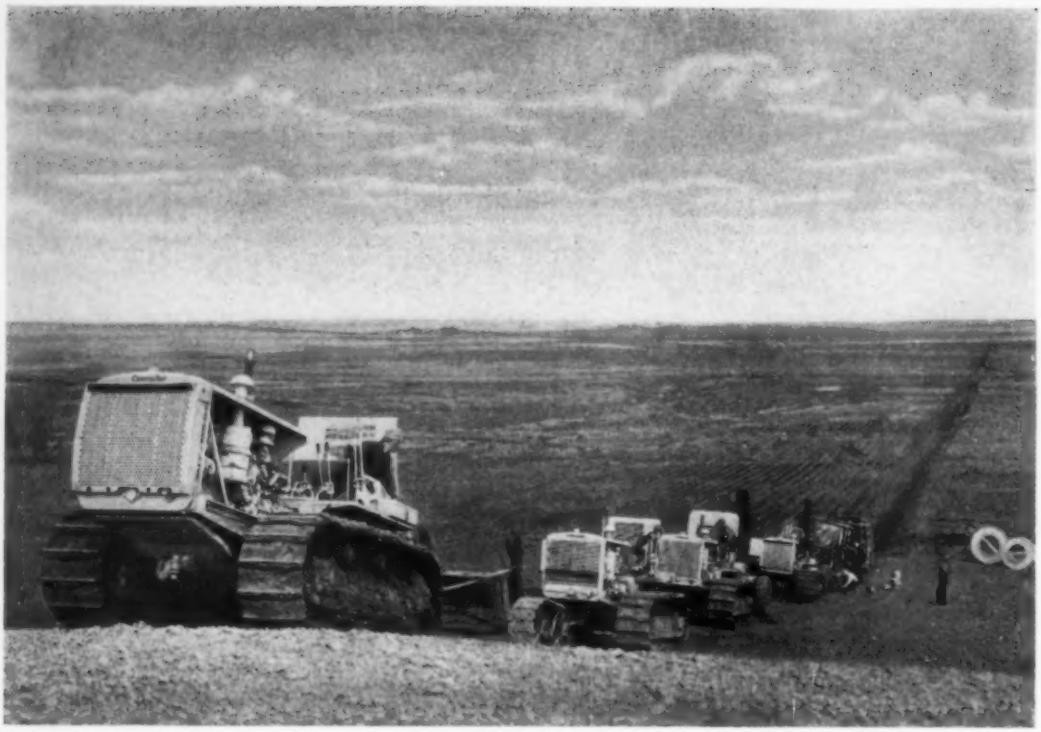


MODERN PIONEERING

This is one of the huge tractor trains which is plowing the twin transcontinental telephone cables into the ground along the route from Omaha, Neb., to Sacramento, Cal., to link the eastern and Pacific toll cable networks. See "Engineering the Transcontinental Telephone Cable," in this issue.

TELEPHONES AND DEFENSE

AS this country gears up more and more to the achievement of a condition of impregnable defense, a fast, dependable, nation-wide telephone service is of incalculable importance: in the creation of Army camps and Navy bases and the training of great numbers of men; in the building of huge factories and the operation of plants both new and long established; in the transportation and distribution of raw materials and finished products; in the administration of the vast new and special activities of the Federal Government—in all the innumerable consequences of the hurried transformation of a whole people from a state of peace to one "short of war." To keep pace with the present unexampled demand for telephone service is the grave responsibility of Bell and independent telephone companies, whose interconnected lines, and manufacturing facilities as well, are being called on as never before in the maintenance of the time-schedule of defense.

How the Bell System is meeting its responsibility is best told by the line gangs who are placing wire and cable at top speed, by the installers who are putting in telephones and switchboards in unprecedented numbers, by the operators who are handling more calls than ever before, by the heightened tempo at the Bell Laboratories, by the day-and-night shifts at Western Electric's great factories.

Parts of that story have also been told in this MAGAZINE. In the issue of February, 1941, "The Bell System and National Defense" gave a summary of how the System had risen to the situation by the first of this year. "Engines for Defense," in the May issue, told of one aspect of the preparations for an emergency. "Western Electric: Telephone Arsenal," last August, reported how the System's manufacturing and supply organization is keeping pace with the demand for communication equipment to meet requirements of both civilian needs and our armed forces. Two briefer statements by President Walter S. Gifford of the American Telephone and Telegraph Company (in the issues of October, 1940, and May, 1941) were recapitulations. In the following pages of this issue appear three articles which bring sharply into the foreground the extent to which the Bell System is contributing to the defense program. "An Operating Telephone Company's Part in National Defense,"

which begins below, has been written especially to supplement the articles just named. "Providing Substitutes for 'Critical' Telephone Materials," and "The Present Situation and the Present Outlook," which follow, are statements recently prepared for the information of employees and already given some circulation in the Bell System; they are included here as contributing materially to the perspective of the whole picture.

AN OPERATING TELEPHONE COMPANY'S PART IN NATIONAL DEFENSE

Furnishing Service Quickly to New Army and Navy Establishments, Defense Plants, Boom Towns, and Expanding Industry Creates Problems Which Can Be Met Only by Extraordinary Exertions

BY HERVEY ROBERTS

Of the 24 operating companies of the Bell System, the Southwestern Bell Telephone Company is, whether in point of area served, telephones owned, or number of employees, neither the largest nor the smallest. In the territories of the other Bell companies there may be more camps, more men in training, more defense plants, more mushroom towns—or there may be fewer. All of these companies are meeting the demands for communication which national defense is creating in their areas. This article, which narrates the intense activity of the Southwestern Bell arising out of the country's defense program, may be regarded as representative of the way in which all the System companies are responding to the present emergency.

WHEN more than a billion dollars is suddenly poured into one section of the country for Army camps, navy bases, air fields, shipbuilding yards, chemical and steel plants, airplane factories, and all the miscellany of a national defense emergency; when thousands of workmen and their families swarm to cities where defense building is going on; when towns double their population in a few weeks, and tar-paper shacks and old chicken sheds are snatched for houses; when ordinary business zooms from the additional pay checks and the clamor for supplies; and when, on top of all that, two of the country's four Armies start practicing for the largest peacetime maneuvers in the history of the United States . . . well, normal ways of living and doing business are likely to go by the board. And just incidentally, it's likely to present some problems to the telephone company furnishing service in that area.

That is exactly what has been going on in the territory of the Southwestern Bell Telephone Company during the

ROOM FOR EXPANSION

Behind the protection of the temporary walls, service is rendered as usual in the central office at Victoria, Tex., as work starts on a two-story addition made necessary by the creation of an Army air field near by

last year or more. Of course, much the same thing is taking place in other parts of the country; there are larger defense factories in the East, and bigger Army maneuvers in the South. But Southwestern Bell territory—Missouri, Arkansas, Kansas, Oklahoma, Texas, and a bit of Illinois—furnishes a good cross section of the defense effort because to some extent it is getting in on practically everything.

Southwestern newspaper headlines for months have been reporting daily additions to defense activity: a $30,000,000 TNT plant at Weldon Springs, Mo.; a $5,000,000 shipyard at Houston built in 100 days; the largest air base in the world, built at Corpus Christi for the Navy; more than a score of Army camps, new and enlarged; airplane factories and air fields; chemical plants and munition dumps . . . the list runs on and on.

And each in its way has offered a challenge to the telephone forces.

JUST as a sample, at Freeport, Tex., a $10,000,000 addition was made to a magnesium plant. Result: the number of workers at the plant jumped from 550 to 2000—a fair-sized increase for one factory in a town of 2600. And that's not all. When building began, nearly 5000 construction workers poured into Freeport—nearly twice the town's normal population. So strained were living accom-

LINES IN A HURRY

Telephone service is one of the first requirements of the contractor building a defense project—in this case Camp Robinson, Ark. Permanent facilities come later, when requirements for the camp itself are definitely known

modations that some of these men had to stay in Houston, and drive 125 miles a day to and from work.

Even more spectacular, a small-arms munition plant employing 8000 workers is now in operation at Lake City, Mo., which early last spring had a population of 30! And these are just two examples.

This tremendous expansion, plus the acute need for speed, has faced the telephone industry with some major problems—just as it has, of course, many other industries. For when factories costing millions start rising in the middle of flats previously inhabited by sea gulls, and Army camps spring up among the scrub oaks and armadillos, the job of rushing in telephone facilities is by no means simple. It can be done, and it is being done. But it has taken some fast action.

Action through System

STILL, the problems are somewhat similar to those raised by storms and floods, and it has been possible to solve them with methods used to meet such "normal" emergencies. The Southwestern Company bases its system upon a series of special committees similar to those formed for emergency storm restoration. At the top is a General Defense Committee for the company as a whole, composed of the General Sales Manager as chairman, the General Commercial Engineer, the General Plant Supervisor, the General Plant Extension Engineer, and the General Traffic Engineer. As chairman, the General Sales Manager also acts as chief liaison man in the company's dealings with Government officials on defense projects.

While these are the regular appointed members, actually the committee is a flexible and informal group, and anyone in the general departments may be called upon to sit in on specific jobs. The idea is to get the work done as smoothly and as quickly as possible. Similar committees are organized in each of the company's four areas, which correspond in general to state lines except that Arkansas

and most of Missouri are combined in one area.

The committees cover a wide range of activities. One of their most important tasks is to keep informed of the new defense projects that enter the picture, including where each new project is to be and when it is to start. Unless such information is received in plenty of time, the company may find it difficult to be ready when the inevitable rush begins. The Army, which is supervising much of the defense industry expansion, has been very cooperative in providing this information as soon as it is available.

The committees also watch such things as force adjustment, to make sure that enough plant men, engineers, and operators will be available for the new jobs. They work closely with the Army and Navy, and, in the case of the general committee, with the American Telephone and Telegraph Company and with neighboring Associated Companies. With the wholehearted coöperation of the Western Electric Company, they have proved themselves adept at seeing that, no matter how urgent a new order may be, needed supplies can be provided for the job without delay.

A SERVICE ORDER

Not all the telephone work for defense is done in the field. This is the order written for telephone service for the new plant of the Beech Aircraft Company at Wichita, Kan.

LET us assume that word is received that a new airplane plant is going up in the country outside of Tulsa, Okla. There will also be a housing project, financed by the government, to take care of the workers. Perhaps there are only a few rural lines in the neighborhood.

The Oklahoma people go to work immediately, both at Tulsa and at state headquarters at Oklahoma City, even before official notification is received that the plant and houses will be built. On the basis of all the information they can gather, they decide approximately what telephone facilities will be needed for the construction contractors, for the plant itself, and for the people who will live in the new houses. Past experience has proved a trustworthy guide, and it is highly probable that the advance estimate will come out very close to what will be actually needed.

The advance figure on the amount of material and labor that seems necessary is telephoned to St. Louis,

where approval is obtained—over night, if necessary—for ordering the material. The order is placed, and Western Electric gets under way at once. By the time the new plant is ready for the work, the material is usually ready for delivery. The formal estimate, upon which normally every move must depend, may not be submitted for approval until the work is well started.

What amount to double jobs are almost standard now for defense expansion. First comes a small manual PBX for the contractor, and other activities involved in construction, plus, perhaps, teletypewriter service. Then, as the building nears completion, a dial PBX is installed to serve the communication needs of the plant itself.

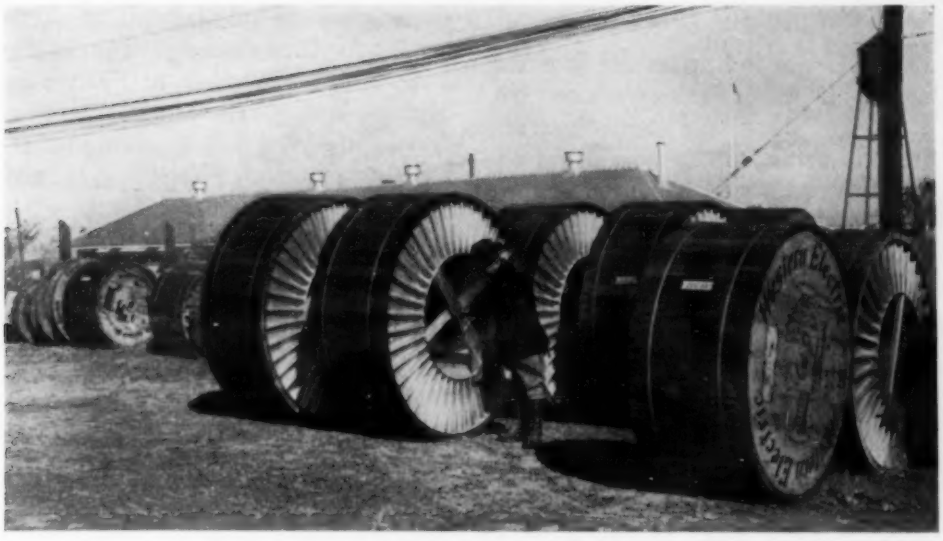
NATURALLY, this putting in and taking out of PBX's has kept the Plant Department fairly busy. But on top of that, nearly every defense job has also meant a big outside construction program. Most of the defense plants, as well as the Army establishments, are located outside city limits, and many of them have housing projects associated with them. The combination requires new facilities in territory perhaps five or ten miles from the central office. In many instances it is necessary to string open wire circuits for the contractor's immediate needs, following along with a permanent cable later.

But other things happen to the telephone company, too. Victoria, Tex., where an advanced air training field is being built for the Army Air Corps, is a good example. Weeks before work started on the field, the number of local calls at Victoria began shooting up, while the volume of long distance calls went out of sight. Naturally, there would be even greater traffic when the field was completed, to say nothing of the volume contributed by the new families that were certain to be drawn into town.

When Victoria was converted to a common battery system, only five years ago, it had eight toll and six local positions. On April 1 of this year there were eleven toll and eight local, and the activity at the field had just started. Careful estimates indicated that by May 24 a four-position toll table would have to be added; by October another local and two more toll positions; and by July of next year two more local and two more toll, or a total of 30 positions as compared to the original 14.

One trouble was that 19 positions jammed the operating room. The last one literally touched the rear wall of the building. Not another jack could be squeezed in—much less eleven more positions. So the end of the building was knocked out, and 28 more feet added to both stories. This allowed room for all the estimated new positions, with space for more if they are needed. Incidentally, the operating force at Victoria has increased from 33 a year ago to 54 at present.

AT Grand Prairie, Tex., the changes were relatively even greater. Three years ago Grand Prairie was cut in as an agency office, with a two-position switchboard. Things went along quietly for two years. Then last summer North American Aviation started building a huge new airplane plant which will employ 10,000 persons by



CABLES FOR DEFENSE

A Southwestern Bell cable splicing foreman inspects the reels in the storage yard at Camp Robinson

the end of this year. A housing project brought additional activity, while a Naval Reserve airfield, next door to the factory, took on new life as a primary training field for the Navy. Local calls and telephone installations rose in a flood. Long distance calls jumped from 50 a day to 800, with far more in prospect. The operator hurriedly moved her residence to another house; part of the telephone equipment was moved to her former bedroom, a wall was torn out so that the kitchen could be added to the operating room, and five new switchboard positions were put in—just as a starter. Now chief operator, she has twelve girls working for her, and more must soon be added.

Such force increases have brought problems for the Traffic Department in their train. You don't expect to find enough trained operators in a small town to permit doubling and quadrupling the force in a few weeks. Part of the need can be filled by transfers, but in addition it has been necessary to train new girls at some of the smaller places.

THESE localized shortages of operators, however, have proved one thing again: that the Bell spirit sticks even after telephone people leave the service. Just as former operators frequently volunteer to help in time of storm or flood, quite a few are now coming to the "tight" offices and saying, "I know you're short-handed, and I'll be glad to help until you can pull out of the hole." In many cases these girls are wives of the men who have come in to build or work at the new defense plants. The girls may have worked for Michigan Bell or Pacific Tel. . . . but as far as they're concerned the Southwestern is part of the family, and they want to lend a hand.

Service for the Camps

BUT defense industries are just one aspect of the telephone's new job. There are also Army camps and airfields to serve, to say nothing of the world-record Naval Air Base at Corpus Christi, which 18 months ago was a stretch of sand dunes and mesquite. The new additions vary considerably in size, from 1000-man reception centers to full-fledged camps for 35,000 to 40,000 troops such as Fort Leonard Wood in Missouri. But the story of one is pretty much the story of all, so let's take Camp Wolters, a medium-sized infantry replacement center at Mineral Wells, Tex., as typical.

Last fall Camp Wolters was nothing but 8000 acres of pasture and scrub. But when the contractor got under way last November, the camp popped into being like a field of mushrooms. Using the system that is standardized on these camp projects, bulldozers first scraped off the scrub, and then pushed the hills casually into the valleys. To give you an idea of the way these bulldozers work, at one period it was planned to set some 30-foot poles across a low spot. The contractor suggested waiting until the next morning, as during the night the bulldozers were going to push a hill into that hollow, and the dirt would cover the tops of the poles. That's a long way from a man with a shovel!

As soon as the camp site was leveled, a railroad spur was rushed in, a hard-surfaced main road and a system of streets was started, and the buildings themselves began springing up. By March the camp was partly garrisoned and troops were in training.

When work first started, the usual request was made to furnish telephone service for the contractor: two 80-line PBX's and a number of circuits to Mineral Wells. The material was ordered November 12, the first switchboard was working November 18, and the second was in by the 22nd.

The switchboard for the camp itself was ordered January 7, and was in service February 12—three weeks before schedule. Ahead of schedule or not, the board was put to work immediately.

Meanwhile, telephone construction gangs were brought in from as far away as Houston, until finally 32 crews were on the job. These included two oversized cable gangs, one of which had 13 men. Thanks to the number of men, and the coöperation they received all the way up the line, these gangs did a little record-breaking of their own. Some toll circuits to Abilene, which normally would have taken 100 to 120 days to put in, were up and working in 20 days. On the local end, a 50-pair cable was run in from Mineral Wells for the contractor, and later, when the Army's requirements were definitely known, a 200-pair cable went in for the camp's permanent facilities. It was in use two days before the date set by the Army.

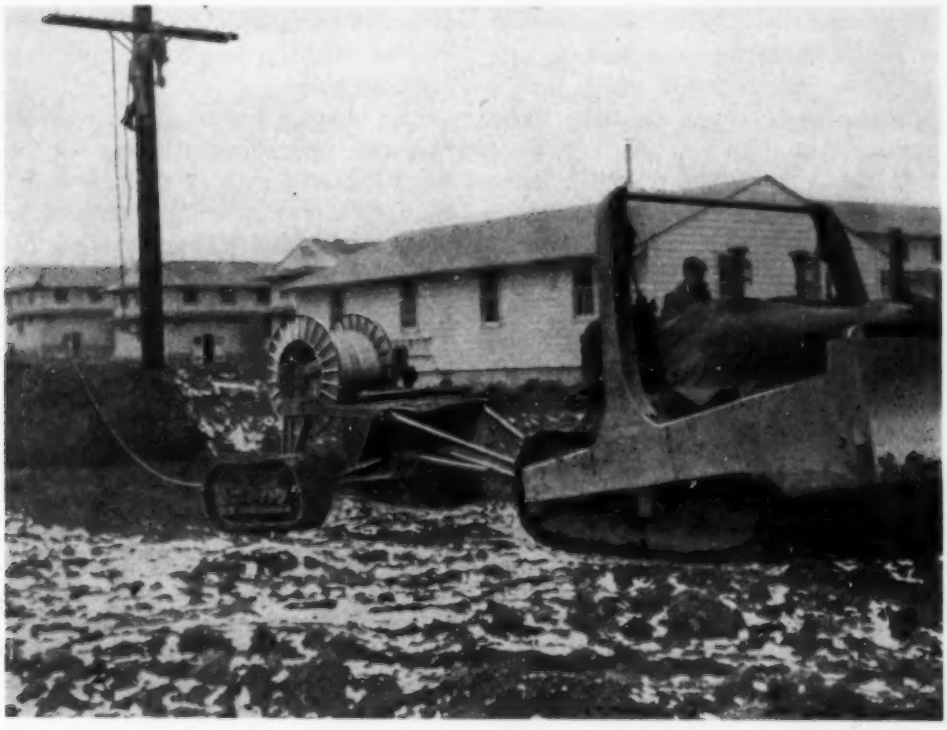
WHILE all this sounds smooth enough, there were a few minor interruptions, some more amusing than serious. The contractors were jumping so fast that in a couple of cases they literally moved their shacks out from under their telephones, leaving the instruments lying on the ground. And the ubiquitous mud, chief enemy of camp construction all over the

country, insisted upon bogging down telephone trucks as well as everyone else's.

Bad as the mud was, though, the crews at Minerals Wells had an easy time compared with gangs putting in some toll circuits to Camp Wallace, a coast artillery replacement center near Galveston.

Four miles of this toll lead runs through a typical Gulf Coast swamp—a swamp that's bad enough normally, but that had become soupy muck through weeks of steady rain. It was too thin for trucks, and too thick for boats. So three teams of mules were hired, three wagons were stripped down to wheels, axles, and poles, and the necessary crossarms and hardware were hauled in. So bad was the mud that 12 crossarms were a full load for a team, and even then the mules would play out. They would lie down to rest, and the men would have to hold their coats under the mules' noses to keep them from drowning! To get in the wire, the reels were set up on the highway, and one strand would be hitched to a mule. Then the mule would drag that one wire through the bog, the reel unwinding as he pulled.

Just to complicate matters, at one point the gangs ran into a few mosquitoes . . . a few thousand, that is. The men were already wearing boots,



"GENERAL MUD" TAKES A HAND

Caterpillar traction, and caterpillar mount for the cable reel, helped to get cable in on schedule at Fort Leonard Wood, Mo.

slickers, and gloves, but to protect their faces they made hoods of slicker cloth, cutting holes to see and breathe. It was probably the weirdest-looking construction gang on record, but it was better than being eaten alive.

MUD didn't cause all the chuckles, though. One day at expanding Fort Riley, Kan., a building contractor rushed in and said he had cut a telephone cable. There was no sign of trouble, and he was so assured, but he insisted he knew a telephone cable when he saw it. Investigation showed it was a telephone cable all right—a piece of underground that had been abandoned back in World War days!

The prize story also goes to Fort Riley. Shortly after the selectees had started coming into the fort, a long distance call came through for a private named approximately John Smith, outfit unknown. As there were then about 5000 regular and selectee troops on the reservation, the operator asked for further identification. She got it thus: "He's blond, has curly hair, and one gold tooth."

It hardly seems fair to neglect the story of the air bases, both Army and Navy, in Southwestern Bell territory, because this region is one of the major air training centers of the country. Besides the Corpus Christi base, it contains the Randolph-Kelly-Brooks Field group, the "West Point of the Air," at San Antonio, and more than a score of other military air training fields, exclusive of the regular Army air posts. But the telephone jobs at these fields have been similar to those already described, and further comment would be mere repetition.

Building lines and installing telephone equipment isn't the only way in which Southwestern Bell has helped the Army, however. Unorthodox arrangements have been worked out to enable them to meet unusual conditions. For instance, a number of small PBX boards have been rearranged for use as portable switchboards in the field, some of them mounted in Army trucks. Some of these boards, used for specific situations during maneuvers, are designed to juggle magneto and common battery circuits in a manner that would never be needed under ordinary circumstances. In one case, Plant men assigned to help the Army during maneuvers designed a system whereby teletypewriters could be made to operate over field wire laid on the ground, with its insulation wet from constant rain.

Less obvious, but no less important, was some specialized training for the Army. Faced with all their new and enlarged camps needing communications service, and with a sudden addition of hundreds of new men to the Signal Corps, the Army last year forehandedly started expanding the group of instructors who are now teaching the new Signal Corps men their jobs. The communications companies were asked to help in certain phases, and all last fall the Southwestern Bell conducted classes in teletype operation, PBX maintenance, station installation, and central office work. In a number of camps, experienced operators have been assigned to teach soldiers how to operate switchboards.

Service during Maneuvers

THE maneuvers mentioned earlier are an entirely different phase of the

RIGHT AT HOME

The Post Signal Officer, going over plans for the switchboard at Camp Funston with Western Electric installers, was a facilities engineer with the Southwestern Bell Company until he donned khaki

telephone company's defense job. They involve many of the regular defense activity problems, such as rush orders for major construction, but they also add a few of their own.

In the last year there have been three maneuvers in Southwestern territory: one in East Texas last fall, a Second Army action in Arkansas this August, and Third Army maneuvers that started in West Texas the first part of August, and then moved to Southeast Texas and Louisiana the latter part of the month. These last two were preliminaries to joint maneuvers, largely in Southern Bell territory, during which the Second Army defended against the invading Third.

Both for tactical reasons and to avoid disrupting civilian life as much as possible, the Armies chose the most sparsely-settled sections of the areas for their practice. For these objectives the country chosen was excellent: enough stretches of mesquite in Texas, and cypress swamps and pine hills in Arkansas, so that only a few towns need be involved. But from a communications standpoint it wasn't so good. Most telephone lines stay away from hill and swamp areas.

THE Army, of course, handled the actual operation of its communications, using its own switchboards, soldier operators, and Signal Corps men. It also strung hundreds of miles of field wire between different units. But the backbone of its communications network was the regular com-

PORTABLE CENTRAL OFFICE

Southwestern Bell men helped the Signal Corps to mount this magneto switchboard in an Army truck

mercial lines; for, rather than run lines between units which might be many miles apart and frequently on the move, the Army leased toll circuits between the two nearest towns, and ran its own lines from the unit headquarters to Southwestern Bell lines.

Naturally, the Army requirements had to be superimposed upon those for regular civilian usage, with as little disturbance of the latter as possible. Moreover, non-Army telephone usage was certain to increase, rather than decrease, during the maneuver period. General business was certain to boom (El Dorado, Ark., had one million-and-a-half-dollar payday that practically cleaned out the stores), and long distance was sure to jump as merchants frantically tried to replenish stocks. On top of that, several hundred thousand soldiers, and hundreds of visitors, were going to be making calls, to say nothing of the first-class service that would be needed by newspaper and radio men covering the activities. Obviously, facilities normally adequate for the maneuver areas would be hopelessly swamped.

THE Army, however, has always proved very considerate, and as soon as its plans were developed, they supplied a fairly complete picture of what could be expected. Weeks before the troops moved in, the Southwestern Bell was able to swing into action. Construction crews from Oklahoma and Kansas were brought into Arkansas to help the local forces there, and gangs from different parts of Texas were concentrated in the Texas maneuvers areas. In both cases, special groups of Plant, Traffic, and Commercial men were assigned to devote their

entire time to the Army "for the duration."

The biggest construction job had to be done in a section running roughly from Gurdon, Ark., to El Dorado and the Louisiana line. In this area more than 1700 miles of new lines were strung; circuits were rearranged, and 26 new carrier terminals were installed. New positions were added to the switchboards in Gurdon, Prescott, Camden, and other towns, some of which are served by independent telephone companies. Western Electric poured in supplies literally by the carload: 4500 crossarms, 50,000 insulators, 45,000 locust pins; two and a half tons of tie wire, more than a quarter of a million pounds of line wire.

The construction gangs had their troubles. Temperatures reached 100 and higher every day they were on the job, and shirts became so soaked with perspiration that they shorted circuits temporarily as the men worked among the wires. And to make things worse, there was an epidemic of chiggers. Things weren't nearly so bad on the similar job in Texas. There the worst trouble was that the cows developed a taste for insulation, and would eat it off the field wires.

Despite heat and chiggers, the crews made remarkable time. Using truck-mounted borers to dig pole holes, and hiring mule teams to pull whole cross-arms of wires at once, some of the grouped gangs averaged three miles a day.

Meanwhile, representatives of the

ARMY MESSAGE CENTER

Hidden in the woods during maneuvers, this 35th Division post included telegraph facilities in the trailer at the left, a teletypewriter in the center, and a telephone switchboard mounted in the truck at the right

PULLING IN A WHOLE CROSS-ARM OF WIRES

Local motive power was used in stringing these wires in preparation for Army maneuvers

independent telephone companies involved (there are 28 in the Arkansas maneuver area alone) met with the Southwestern Company to work out arrangements to keep all the work coordinated. This was highly necessary, as one order from the Army might involve several telephone companies. The coöperation of all the companies was excellent throughout the maneuvers, a fact that contributed greatly to the successful handling of the project.

BECAUSE the public was also affected, the company conducted an informative advertising campaign to tell people that there might be delays in telephone service during the maneuvers, and why. An explanation was made of the work being done to hold these delays to a minimum, but it was frankly admitted that service was bound to suffer somewhat. The advertising took the form of newspaper advertisements, inserts in customers' bills, and special posters placed at our own and connecting-company public telephones. It is difficult to tell the exact effect this advertising had, but one fact stands out: not one serious complaint was received throughout the entire maneuvers period.

Thanks to these preparations, and the excellent coöperation from everyone concerned, the job of providing service for the maneuvers was accom-

plished, in general, with gratifying smoothness. And the Army said it was satisfied—which was the important thing. Coöperation throughout the defense job is so excellent and so consistent, however, that only its lack would be cause for comment. Practically everything the Southwestern Bell has done and is doing involves other organizations: the American Telephone and Telegraph Company, its Long Lines Department, the Western Electric Company, independent telephone companies.

The help of the A. T. and T. Company is of great value, not alone in the form of staff assistance and advice but in the handling of matters with the Army and Navy which could not well be settled in the field. There is constant interchange of work with the Long Lines Department, and many a Long Lines circuit has been borrowed to fill an emergency gap. Western Electric has brilliantly upheld its reputation for delivering the goods—usually wanted in quantity, and right now! The independent telephone companies have collaborated closely and whole-heartedly. And too much emphasis cannot be placed on the cooperation of the country's armed forces. Faced with staggering problems of their own, they have been both considerate and helpful in their dealings with the telephone company.

THIS has been the story of what the Southwestern Company has had the opportunity to contribute to the accomplishment of the nation's defense program. Basically, it might have been written about any one of the operating telephone companies in the Bell System.

PROVIDING SUBSTITUTES FOR "CRITICAL" TELEPHONE MATERIALS

As Shortages of Necessary Materials Develop, the Availability of Satisfactory Substitutes Becomes Increasingly Important to Continued Production of Telephone Equipment

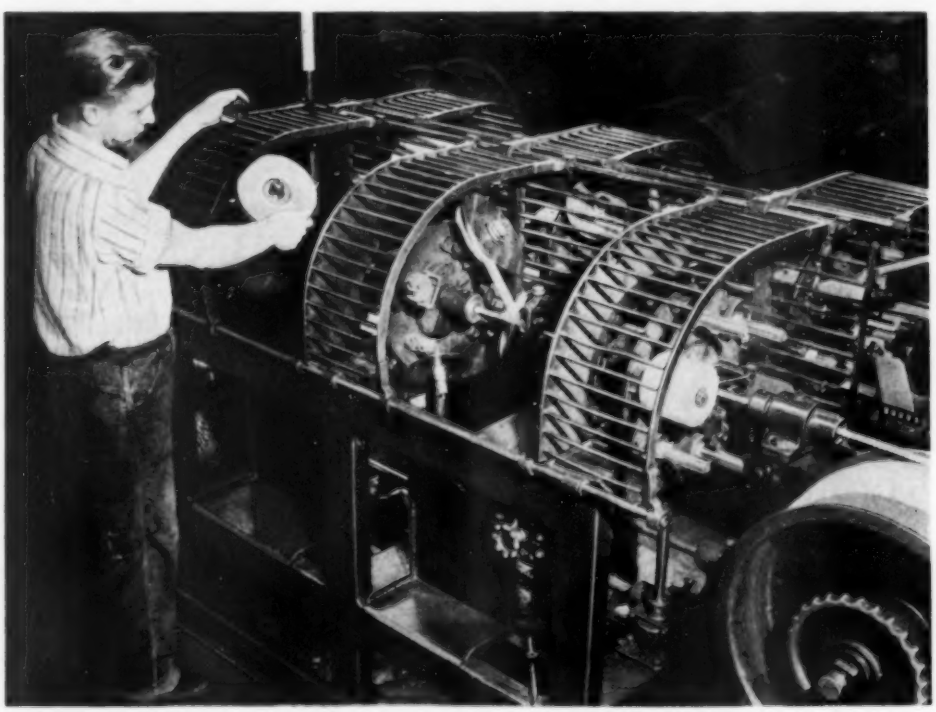
THE present national emergency has given rise to a demand for ever-increasing production. Such production consumes tremendous amounts of many raw materials. As they have become scarcer, the search for satisfactory substitutes has been greatly stepped up. So, too, the Bell System has stepped up its efforts toward thrifty use of the basic materials available.

For some time this vital activity to reduce Bell System usage of materials needed for defense purposes has been coördinated in the System by an Intercompany Committee consisting of the Plant Engineer of the American Telephone and Telegraph Company, the Director of Apparatus Development of the Bell Telephone Laboratories, and the Manager of Manufacture and the General Purchasing Agent of the

Western Electric Company. Back of them, however, the prompt coöperative effort of many other groups is putting the material changes into effect.

DEVELOPMENT of suitable substitutes begins in the Bell Telephone Laboratories. The problem is many-faced, and requires a great variety of skills. First comes the materials engineer, who suggests available materials of suitable properties. Sometimes metallurgists or chemists may be consulted. Apparatus designers then take hold of the problem, to see if the changes in strength, conductivity, or insulation require changes in the form of the part or device. Their knowledge of Western Electric's manufacturing methods is helpful in recommending designs which can be made with existing or slightly modified facilities. In some cases, circuit experts may be called on to decide whether any changes will be needed in existing systems. Finally, manufacturing engineers of the Western Electric Company are responsible for the tool set-ups, and the actual processes of making and assembling the changed parts. The work of these men constitutes a useful function in the defense program even outside the Bell System, for they coöperate with the Government and various engineering societies in developing simplified practices and otherwise alleviating material shortages.

Bell Laboratories' engineers con-



REPLACING A "CRITICAL" METAL

Pliolite-coated paper tape is used instead of aluminum tape in this operation of switchboard construction at Western Electric's plant at Kearney, N. J.

SAVING RUBBER

Wood fibre board substitutes for the scarcer material in assembling terminal strips for central office equipment at Western's Hawthorne plant

sider the technical questions involved and pass on the suitability of available materials to replace those on the "critical list." Manufacturing department engineers at all Western Electric plants review the piece parts affected by the shortage of a given material, consider available supplies, discuss the manufacturing features with Bell Laboratories' engineers, and revise manufacturing information after agreement has been reached on the substitute to be used. Representatives of Western's purchasing department immediately place new orders, revise outstanding contracts, and attempt to keep a smooth flow of new material coming in with a reduced volume of the old. Likewise, the Western Electric works departments carry a large part of the responsibility, in promptly arranging for the new material to be put into stock and adapting their operations to the new material and methods of manufacture.

The Bell System's substitution program has a direct and obvious bearing on the outcome of the defense program. At the present going rate, it will divert for use in the defense effort nearly 1,900,000 pounds of aluminum annually; more than half a million pounds of nickel; well over 3,000,000 pounds of zinc and 8,300 of magnesium. Additional reductions are foreseen for 1942. It is estimated that about 300 fighter planes might be built with the aluminum the System will save from its present annual rate of consumption.

Three classifications have been developed in the substitution work. Class I includes those materials for which substitutes can be introduced as the result of investigation, research, and design work which has already

been done. As an example, Western Electric and the Bell System are substantially reducing their use of zinc by coating much of their outside plant hardware with lead instead of putting these products through a galvanizing process.

In Class II are cases where substitutes may be found, but further work is necessary to determine whether their use is practicable.

The Laboratories are studying the possibilities of using lead foil for condensers instead of aluminum, of which the System would use 250,000 pounds for this purpose this year. The difficulty is to get the lead foil into the same dimensions as the aluminum and thus to avoid a redesign of the entire condenser, which might then be too big to fit into the limited amount of space available in certain assemblies of apparatus.

Class III includes those cases in which engineers have not as yet been able to find working substitutes for the scarce materials, and for which substitution may well prove to be impossible. For instance, there is no known substitute for the zinc electrode in a dry cell, nor, with minor exceptions, is there a substitute for copper.

GENERALLY speaking, the materials used in Western Electric manufacture which have become most critical are copper, aluminum, zinc, nickel, steel, rubber, magnesium, nickel-steel. Some of the other materials which are rapidly approaching the critical state are phenol plastic, phenol fibre, brass and silk.

Western Electric now saves 130,000 pounds of aluminum annually by replacing the aluminum in the dial finger wheel with steel, which serves the purpose adequately. Copper has replaced aluminum in bus bars, and an annual saving of an additional 100,000 pounds of aluminum has thus been effected.

A thermo-plastic is to some extent replacing Zamak, a zinc aluminum alloy, in the manufacture of the housing for combined telephone sets. Since the combination of Zamak is approximately 4 per cent aluminum, .03 per cent magnesium, and about 95 per cent zinc, this is a substitution which releases for other purposes a sizeable quantity of vital metals. Of all the combined sets now in manufacture, 34 per cent of the housings are of plastic composition. At this rate, the annual saving of zinc alone will amount to 1,600,000 pounds.

The defense emergency has, of course, tremendously stimulated the work of the Bell System engineering groups. An immediate survey was made in 1939, based on a study of materials particularly used in the Bell System, and a list of critical materials developed. The list initially consisted mainly of critical materials which were purchased outside of the United States, or the sources of which were beyond control.

Looking to the future, Western Electric's engineers are considering the use of sisal and ixtle, fibrous materials readily obtainable in this hemisphere, in place of jute and burlap for cable construction.

In compliance with an order of the Director of Priorities and in view of the necessity of conserving the supply of rubber, Western Electric plans a gradual reduction of its use of crude rubber which will reach a level of

EVEN SWEEPINGS ARE COLLECTED

Gathered in railroad cars, trucks, operation departments, and from other System sources, this scrap will charge a blast furnace at Nassau Smelting and Refining Company, and will yield copper to be rolled and drawn into telephone wire

more than 20 per cent by the end of the year. This saving will be accomplished chiefly by the use of more reclaimed rubber in rubber compound and reduction in the use of hard rubber by the judicious use of materials having similar properties.

For the purposes of the emergency, temporary manufacturing information permits the manufacturing department to proceed with rapid introduction of substitutes. Because of the many factors involved—processing, engineering, materials and new procedures—manufacturing costs inevitably will rise as a direct result of the use of substitute materials. Nor are manufacturing conditions relieved by the fact that the defense program has greatly stimulated current telephone business, as well as plant expansion.

IN the Bell System, all materials removed from the plant are re-used in the plant, in whole or in part, if it is possible to do so. Materials which cannot be re-used are reclaimed. Reclaiming is the specific function of the Nassau Smelting and Refining Company, a general smelter and refiner of copper, lead, zinc, tin, antimony, and their alloys from secondary sources into commercial forms such as brass, bronze, copper, babbitt, solder and related products. Nassau, which employs 450 persons and maintains a

metallurgical engineering and sales staff, also has the responsibility for the disposition of scrap iron, paper, rubber, and similar by-products from the operations of the Bell System. It is a wholly-owned subsidiary of Western Electric.

Nassau products include bronze billets for drop wire (for consumption at Western Electric's Point Breeze Works), solder for Western's manufacturing and installation departments and for the telephone companies, lead sleeving for the Eastern area telephone companies, rosin core solder, copper wire bar (delivered to rod mills and there rolled into rod for drawing into wire at Western's Kearny and Point Breeze Works), brass billets (shipped to a fabricator and, following the fabrication process, then to the Kearny, Point Breeze and Hawthorne Works), zinc (for Western Electric's use in galvanizing operations, and in the manufacture of brass billets), fine lead wires for protective apparatus.

THE defense production job continues uninterrupted. Meanwhile, behind the lines, so to speak, thrift and ingenuity are at work to provide a constant supply of raw materials for that production and, equally important, to insure that Western Electric's manufacture creates no unnecessary drain on the nation's fund of raw materials.

THE PRESENT SITUATION AND THE PRESENT OUTLOOK

The Defense Program, Creating an Unprecedented Demand for the Bell System's Services, Has Posed Tremendous Problems—Some of Which Have Been Solved, While Others Lie Ahead

IN ordinary times the telephone company keeps a reasonable margin of spare facilities for growth and for emergencies. Ever since the worst of the depression, the business has been growing steadily, and to keep its plant well ahead of the demand for service, the Bell System has made expenditures for new plant construction which total about $1,400,000,000, and net additions which total nearly $600,000,000, for the years 1934 to 1940, inclusive. This year the expenditure for new plant construction will be more than $400,000,000 and net additions will approximate $300,000,000.

These large expenditures are necessary because in the telephone business we can't handle more calls for more people without first building new plant—a lot of it. To take in $1.00 in annual revenue we first have to spend roughly $5.00 for telephones and wires and central office equipment and all the other things needed to render service.

That is an unusually high proportion of plant to revenue—much higher than is needed in most businesses. Moreover, all new telephone plant must be carefully planned to fit in with all the plant already in existence,

since the interconnection of all facilities is needed in order that people may talk with each other by telephone, wherever they are.

This means that relatively long-term advance preparations must be made in order to be ready to handle big increases in business. Here is one of the reasons why ample margins of spare facilities are essential. Here is another reason why the enormous recent increase in the use of the telephone, brought about by the continuous acceleration of the defense program, is causing serious problems for the telephone company.

LET us compare the country's overall use of the telephone today with the situation two years ago, before the outbreak of war in September, 1939.

At that time the Bell System had about 16,200,000 telephones in service and people were using them about 72,000,000 times a day. Now there are some 18,500,000 Bell telephones in service and they are being used about 81,000,000 times a day. In two years the number of telephones has increased more than 2,000,000 and the average number of conversations each business day has jumped 9,000,000.

These increases are enormous. There has never been anything like them before. The increase in the demand for toll service, considered separately, is even more spectacular. The

UP IT GOES!

This new Long Lines cable will provide additional circuits in the important Middle Atlantic industrial area

number of toll and long distance calls for the first six months of 1941 was about 15 per cent greater than for the corresponding period last year, and the increase in the number of longer haul calls was about 27.5 per cent. Comparing the first six months of 1941 with the first six months of 1939, we find an increase of 22 per cent in all toll calls and an increase of 41 per cent in the longer haul calls.

When war broke out in Europe in September, 1939, there was a sudden unprecedented surge of long distance calls—a sort of "nine days wonder" during which all records for traffic over the longer distances were broken. Now, two years later, we are handling more of these calls every business day than in those September days of 1939. What was astonishing then has become commonplace today.

Why has all this happened? The fact that industry is expanding tremendously for defense is only part of the answer. Equally important is the necessity for speed in meeting the emergency. Our national purpose is not merely to arm for defense. It is to do this with all possible speed. The telephone offers one way to speed things up. Hence the great increase in its use. When we understand this, we understand also how grave a responsibility rests on the telephone company.

WHAT has enabled the Bell System so far to meet this responsibility? Two things, mostly:

First, as indicated above, it was well prepared and had sizable margins of spare facilities.

Second, new construction activity has been speeded up about as fast as it could go. By the end of this year, net additions to plant for three years only—1939, 1940 and 1941—will have aggregated something like $550,000,000.

Nevertheless, certain problems have sharpened in the last few months and may become considerably more serious in the near future. One characteristic of the defense program is that ever since it started it has been growing by successive leaps and bounds. The program of a year ago, for example, was succeeded a little later by something much bigger, and today's agenda makes last year's prospectus look narrow in comparison. In a business like ours, where so much planning and so much construction are needed to give the service represented by each dollar of annual revenue, these successive upward jumps complicate the job. Given one set of conditions, we go to work to meet them. But soon the conditions are changed, and it appears that something more is going to be needed to meet the revised situation. This means not only that our original program will fall short, but that some of the time needed to plan a bigger program against some future date has been lost.

In short, if it had been known by anybody a year or more ago that this country was going to organize its defenses on the scale on which it now seems to be organizing them, the telephone company's present problems would be much simpler than they are.

As it is, the repeated acceleration of the defense program has handicapped the telephone builders in their race with telephone users. Recently, usage has been outrunning the growth of facilities. The builders' head start,

BED FOR A CABLE

The men are measuring the depth of an excavation in which a new telephone cable will be laid under the Platte River

in the form of spare plant margins, has been largely used up. Today, in many places, it's a neck and neck race.

This isn't true in all parts of the country, nor of all the types of service we render. It is most true of toll service over the longer routes, and between points where there are particularly heavy concentrations of defense effort. Also, while some of the routes experiencing "unlimited emergency" traffic are main trunk lines, others are spur lines that have never been called upon before to bear any very heavy load. Military cantonments and bases have mushroomed in former corn fields. So have dozens of great industrial plants. The two types of establishments together have given America something like 100 brand-new medium-sized cities, for many of which communications facilities must be built practically from the ground up. And there are more coming. To give service to and from these places, as well as in them, and at the same time to augment facilities between already established industrial centers, is a huge task in itself.

So far, the pressure of demand on long distance facilities has been evidenced mostly in ways like these:

—on certain routes, circuits sometimes cannot be obtained immediately.

—the average speed of service is a few seconds slower than a year ago.

—about 12 people out of every 10,000 who use long distance are displeased with the service to the point of saying so, either orally or by letter, compared with 11 out of every 10,000 last summer.

But today the question is:

"If demand keeps on going up, now that spare plant margins have been absorbed, what can the telephone company do about it?"

Right here another problem presents itself. This is the shortage of materials needed to build the plant needed to render more service. The race between builder and user is becoming, in fact, a sort of obstacle race.

For a long time the Bell System has been studying how to make the most effective use of materials, particularly of new materials as they become available. Such studies were begun as long ago as 1925. Thanks to this advance preparation, the Bell System is now able to make numerous substitutions in ways that interfere as little as possible with the rendering of grade-A service.

However, whenever the opportunity to use the best possible material is restricted, some penalty is unavoidable. Also certain materials have no substitutes for certain uses.

WITHOUT going into all the myriad details of the materials problem, we can see the broad consequences clearly. One is that some parts of our new plant, while they will be well made and capable of giving good service, will not be just as we would like to have them under normal conditions. Another is that substitutions cannot by themselves solve the whole problem. To give only one example, copper may be used in some places instead of aluminum, but there is no generally applicable substitute for copper.

The materials substitution program voluntarily undertaken by the System has resulted in large savings of scarce materials. Recently, however, it has been necessary for the telephone companies to adopt further restrictions and curtailments because of inability to secure sufficient quantities of these materials and in anticipation of further difficulties in obtaining them. These reductions have been made by adopting engineering and economic practices which involve severe penalties.

In doing this, the guiding principle must be to put first things first.

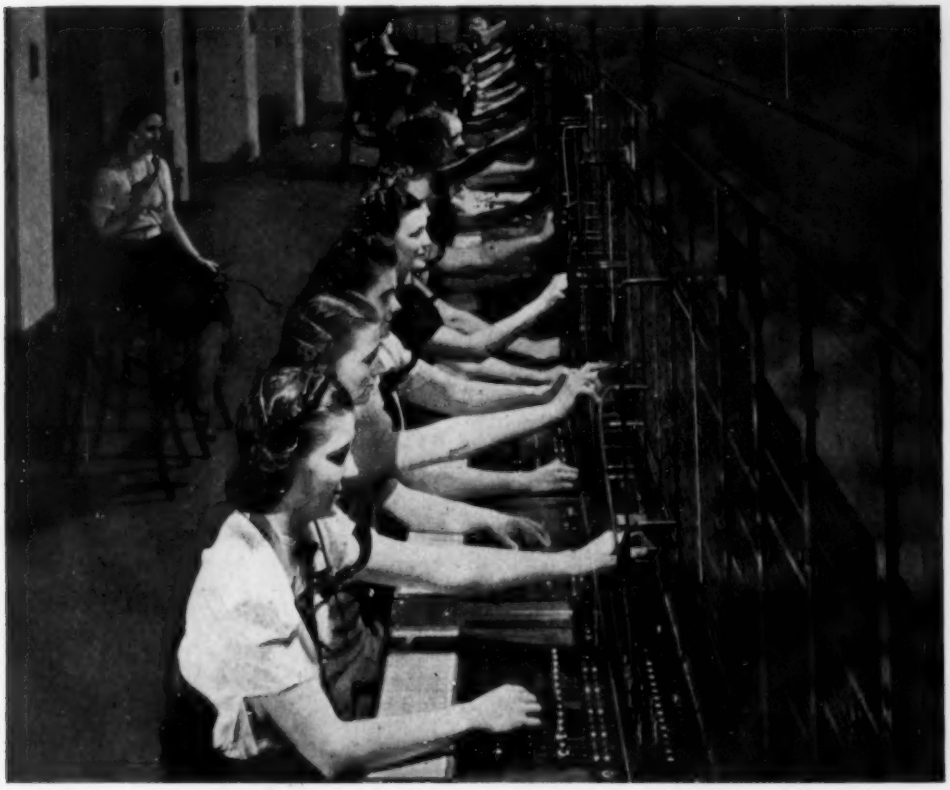
For example, old equipment which might normally be replaced can be kept in service, so that the new equipment which might have replaced it can be used somewhere else where the need is greatest.

Dial installations in some communities can be deferred, used switchboards can be reused, cables can be resheathed and reused, and other similar expedients can be adopted.

If there isn't enough copper to make enough wire to give an individual line to everyone who wants one, people can be asked to accept party line service "for the duration."

Orders for telephone installations that are necessary or important for defense can be completed ahead of other less urgent orders. So far, defense orders have been filled on schedule without the need to ask others to wait.

All these things can and will be done, if they are necessary to keep first things first. That all of them will be necessary we cannot say with certainty. However, it is clear that some of them are already necessary, and it is likely that others will be. Adoption of such measures will not mean that the Bell System is sparing any outlay of effort or money to provide and maintain the best possible facilities and service. On the contrary, the System has never made a more strenuous effort to keep the service

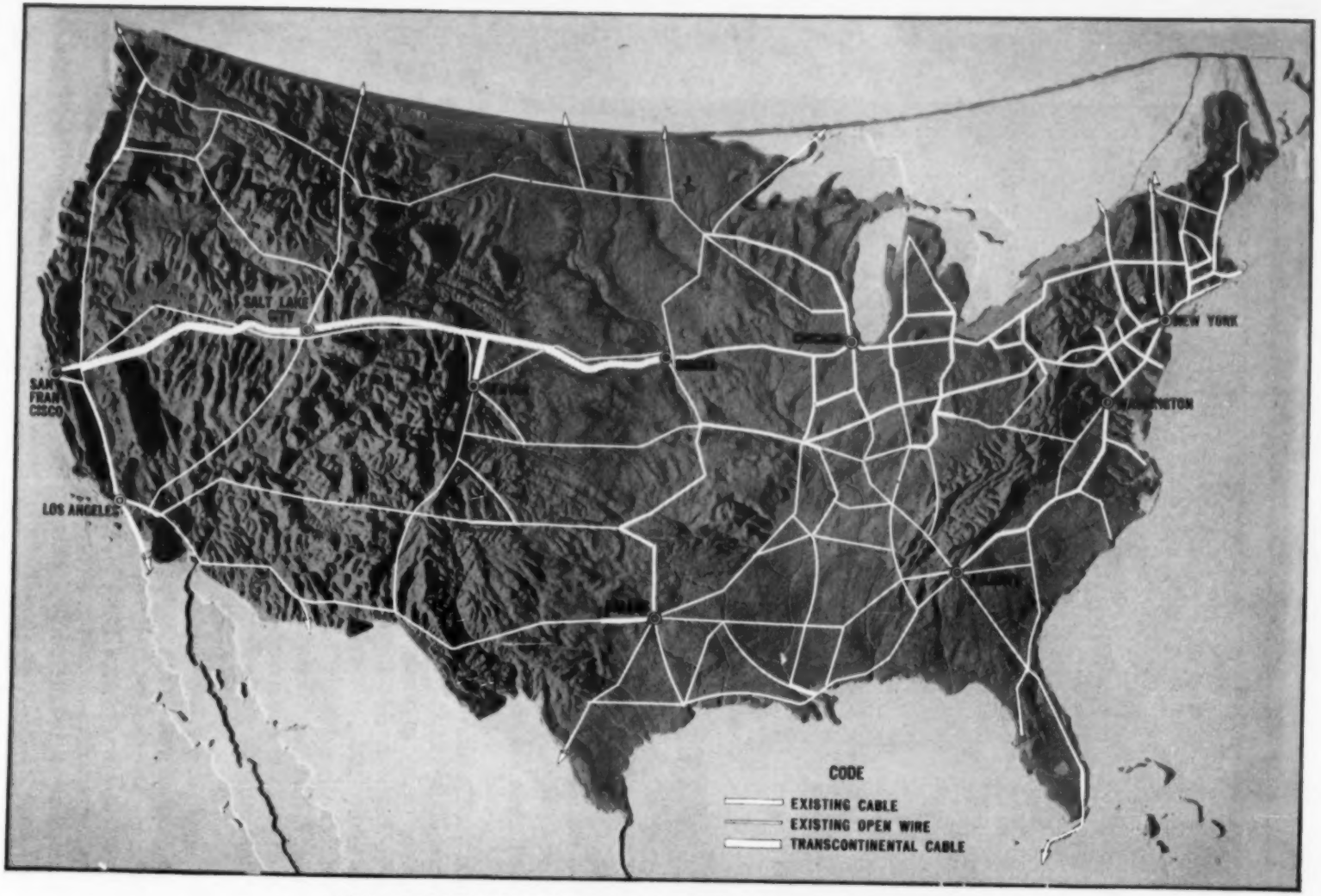


EVERY POSITION FILLED

Long Distance switchboards throughout the country are handling more calls than ever before

good, and some of the figures mentioned above are fair evidence of the current outlay of money. It is obvious, however, that if the unprecedented demand for service which is now being experienced should continue, in the face of possible serious shortages of essential materials, some ground must be given somewhere.

IT may be worth noticing, in conclusion, that were it not for the great technical progress made by the Bell System in recent years, some of the most serious current telephone problems would be infinitely more serious than they are. Thanks to cable carrier systems and cable-laying plow trains, it has been possible to increase long distance telephone facilities at a speed utterly impossible a few years ago, under any circumstances whatever. Thanks to the organization, resources and equipment of the System, the greatest demand in history has so far been met, and met well, and inconveniences to the public have been kept to a minimum. These facts are the best assurance we have that whatever the problems of the future may be, the nation can rely on the Bell System to meet them progressively, and in a manner that will well serve the public interest.



THE TRANSCONTINENTAL TELEPHONE CABLE ROUTE
AND PRINCIPAL EXISTING CABLE AND OPEN WIRE ROUTES IN THE UNITED STATES

ENGINEERING THE TRANSCONTINENTAL TELEPHONE CABLE

This Major Project, Largest Single Undertaking Since the Building of the First Transcontinental Line, Will Join the Eastern and Western Toll Cable Networks by Underground Circuits

BY HORACE H. NANCE

WESTWARD across the plains of Nebraska and the mountains of Wyoming, where a hundred years ago endless herds of buffalo looked up in surprise at the creaking covered wagons of the pioneers, a strange sprawling caravan is grumbling and growling on its way from Omaha to the Pacific coast. The buffaloes and the wagons have long since disappeared, but this caravan again typifies the spirit of the pioneer. The trail it is following is to become a safer super-highway of transcontinental speech.

This caravan is a ponderous steel train of Diesel-powered caterpillar tractors, rooter, plow, and trailers; nine pieces of massive machinery, 275 feet long, weighing more than 100 tons. In one continuous operation it is cutting a narrow slit some thirty inches deep in the ground, laying a pair of long distance telephone cables on the bottom, and covering them up securely behind the train. Two oxen could pull a covered wagon; it would take several hundred to pull this train.

Slowly but steadily, day after day, the cables unwind from massive reels and thread their way smoothly down through the plowshare into the ground. At intervals the train stops to reload the trailers with new reels of cable, then proceeds on its way. Farther west, other trains will hurry the cable on through Laramie, Salt Lake City, and Reno to Sacramento, where it will meet the Pacific coast cable network. Behind the trains come the splicing and testing crews to join the sections of cable and to make tests necessary to insure proper electrical performance. At 17-mile intervals along the route, compact, efficient repeater stations are springing up, many of them designed to carry on for long periods without human attention at the site. From the factories of the Western Electric Company a steady flow of equipment is going to these stations, where installers are rapidly putting it into operating condition and connecting it to the cable conductors.

This work, started about a year ago and expected to be finished by late 1942, will provide a cable link from Omaha to Sacramento, 1630 miles long, connecting the Bell System's eastern and western toll cable net-

works. Although it is being rushed to completion to provide for the unusual traffic requirements due to national defense activities, it is designed to take care of normal growth requirements for some years in the future and to afford increased reliability and continuity of transcontinental service. When completed, it will be possible to talk over practically storm-proof cable from Bangor, Maine, to San Diego, California, a total distance of nearly 4000 miles.

BECAUSE of the nature of the territory traversed and the great length of the cable circuits which will be routed through the completed system, many unusual and interesting problems are involved. Some of these will be touched on here, but they can only be illustrative of the vast amount of research and of detailed planning which underlie a project of this kind and magnitude.

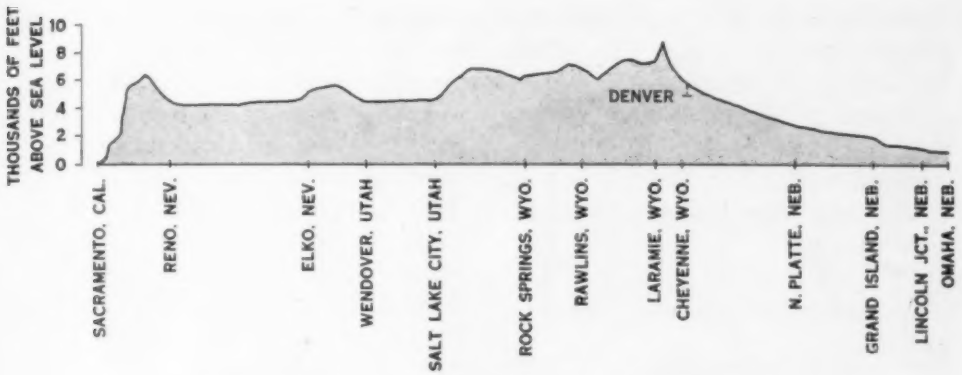
This project is a joint undertaking of the four Bell System companies whose services are handled along the route: the Long Lines Department of the American Telephone and Telegraph Company, the Northwestern Bell Telephone Company, the Mountain States Telephone and Telegraph Company, and the Pacific Telephone and Telegraph Company. The Lincoln Telephone and Telegraph Company will also acquire an interest in the cable through the territory in which it operates.

The new cable link consists actually of two cables, each carrying 54 or more pairs of wires. Most of the wires will be left non-loaded for the application of 12-channel type-K carrier systems, one cable being used for carrier transmission in one direction and the other cable for carrier transmission in the opposite direction. Some wires will be equipped with loading coils and used to provide voice-frequency circuits for the shorter haul traffic and maintenance requirements.

The section from Omaha to Laramie, with a branch from Cheyenne to Denver, some 645 miles in all, is now nearing completion, and will be placed in service this year. Forty-eight circuits will be provided initially through this entire section by means of type-K systems, and thirty-six of these will be extended west of Laramie to Salt Lake City and Pacific coast points on additional carrier systems now being installed on open wire. Additional circuits will also be provided this year to serve intermediate points along the route.

When the cable is completed to the coast, next year, sufficient type-K systems are expected to be put into operation to provide about 100 additional circuits, and ultimately, when the cable is completely equipped with carrier, it will provide a total of 500 to 600 circuits. The cost of this cable, with its initial equipment, is expected to be about $21,000,000.

ACTIVE engineering work on the transcontinental cable has been proceeding for several years. To view this important project in its proper perspective, it must be remembered that universal service was a definite objective of the Bell System from its inception, and that the extensive technical advancement and engineering effort of the System has continuously been brought to bear on current problems of extending service or of im-



PROFILE OF THE TRANSCONTINENTAL CABLE ROUTE

proving it by the use of new instrumentalities. The establishment of transcontinental service on January 25, 1915, was the result of the coordination and application of the technical advances made by the Bell System up to that time in outside plant construction, the design and construction of loading coils, and of telephone repeaters with their associated hybrid coils and balancing networks.

Transcontinental Development

AFTER the initial years, during which additional transcontinental facilities needed were provided by the stringing of additional open wires, carrier current development reached the commercial state, and carrier systems were put into transcontinental service between Chicago and Sacramento in 1926. This was the type-C, three-channel system, and more systems of this type were added from time to time as transcontinental traffic increased.

By 1937, four main transcontinental open-wire routes had been constructed, and type-C systems were operating on them. These routes were the Northern, which went west from Minneapolis; the Central, via Denver and Salt Lake City; the newest one, known as the Fourth, west from Oklahoma City through Albuquerque; and the Southern, from Dallas via El Paso. As additional circuits were provided from time to time, attention was given to maintaining a good distribution of traffic over the various routes, in order to minimize the disturbance to service which could occur if one of the routes should be put out of commission by storms or other destructive forces.

Carrier-current development work continued, and in 1938 the first of the 12-channel, type-J carrier systems for open-wire lines was applied to the Fourth Transcontinental Route between Oklahoma City and Whitewater, Calif., an existing point on the Pacific Coast toll cable network. The type-J system utilizes frequencies extending up to 140,000 cycles, operates on the same pair of wires with an existing type-C system, and affords a somewhat better quality of message circuit transmission than had previously been obtained on open wire.

By the time the first type-J system had been placed in service, the toll

cable network from the east had reached Omaha, Kansas City, Oklahoma City, and Dallas. On the Pacific Coast, toll cable was already available from San Francisco to Sacramento and to Los Angeles, and extended east from Los Angeles as far as Whitewater.

Transcontinental Cable Needed

FOR a considerable number of years it has been evident that the fast growth in the transcontinental telephone traffic would soon tax the capacities of the open-wire lines, and that a tronscontinental cable would ultimately be required. The growth, even in the late 20's, had indicated this, and some studies and tentative plans for cable were made at that time. Since this was prior to the development of carrier systems for cables, the tentative plans contemplated a full-size cable similar to those already installed east of Omaha.

The business depression, and later the development and application of 12-channel carrier systems on open wires, deferred the cable plans. The rapid growth in the last few years, however, and now our urgent national defense requirements, combined with the need for increased protection to the important transcontinental services, have made it obvious that cable should be extended, as fast as possible, to the Pacific Coast. Today there is a total of about 250 Long Lines circuits on the four transcontinental open wire routes passing through a meridian just east of Denver and about 200 circuits on these routes west of Denver. There were only three circuits in 1915 and less than a hundred up to six years ago, west of Denver.

As an illustration of the growth in the longer haul traffic, data for the four longest message circuit groups are given in the table at the bottom of the page.

The rapid growth in transcontinental business is due to a complex combination of factors. Important among these are the growth in population of the western states during this period, and the development of industries on the Pacific Coast, such as the motion picture industry. Added to these is the growing community of interest between east and west, and, of course, the effect of better and faster long-haul service at lower rates.

Circuit Group	Average Daily Messages for Months of Mar., Aug., and Oct.			
	1920	1926	1930	1940
New York–San Francisco	13*	26*	107	215
New York–Los Angeles	7*	43*	222	413
Chicago–San Francisco	20	39	136	267
Chicago–Los Angeles	7*	46	164	244

* Direct circuits between terminals not available in these years. Traffic (partly estimated) switched over other groups.

WESTWARD VIEW

A Long Lines engineer studies the lay of the land

Deciding on the Route

IN planning the general route to be taken by the cable, it was necessary to consider a number of factors, such as:

(*a*) The volume of traffic and length of circuit routings, via the cable, between centers in the eastern half of the country and centers on the Pacific coast. Likewise the volume of traffic that would be routed through the cable to intermediate points on the route.

(*b*) Suitability of route for installing and maintaining buried cable and repeater stations and otherwise obtaining maximum protection to the over-all transcontinental service.

(*c*) Initial and future costs.

(*d*) Extent to which the cable may permit later removal of open wire plant, and protect the remaining open wire lines.

Long distance traffic from the east to the Pacific coast now divides about 60 per cent toward Los Angeles, 25 per cent toward San Francisco, and 15 per cent toward the Pacific northwest. With the greatest amount of traffic flowing toward Los Angeles, it seemed that cost factors might favor a route heading directly for that point. However, Los Angeles and San Francisco are already connected by cable, and the Pacific Company is proceeding with the installation of supplementary cable and 12-channel carrier systems over that route. Studies indicated that there would be no controlling cost advantage in routing the transcontinental cable directly toward Los Angeles, as compared with routing it toward San Francisco.

An important consideration was the need for providing additional circuits into Denver, the largest center between the western outpost of the ex-

WITH TRANSIT AND ROD
The route to the west becomes definite

isting toll cable network and the Pacific Coast, and the studies showed that it would be desirable and economical to connect Denver to the cable network within a very few years, regardless of the route to be taken by the transcontinental cable. It appeared highly desirable that Salt Lake City, the second largest city in the Mountain States region and a natural communication outlet for the Pacific northwest territory, should also be served by the cable.

From the standpoint of reliability of service and future maintenance costs, buried type of cable construction has been favored for this project. As a part of these studies, therefore, an investigation to determine the extent to which it would be practicable to bury cable was undertaken on three general routes.

ONE of these routes was from Omaha to Sacramento via Cheyenne and Salt Lake City. Another route was generally common to this as far west as Salt Lake City but then diverged southwestward directly toward Los Angeles. A third route, starting from Kansas City, passed through southeastern Colorado to Albuquerque, N. M., and thence followed the general route of the Fourth Transcontinental open wire line to Los Angeles.

Studies of available soil data, supplemented by a large number of test borings to determine whether rock would be encountered near the surface, showed that, with the exception of comparatively short sections, cable could readily be buried over the Omaha-Sacramento route. On the route from Kansas City to Los Angeles, however, and also on the route from Salt Lake City to Los Angeles, conditions were not favorable for burying cable for some 280 miles on the former and 130 miles on the latter. A general route via Cheyenne and Salt Lake City toward San Francisco, therefore, appeared preferable to the other routes from the standpoint of this objective.

The installation of cable on the route from Omaha to Sacramento will permit the ultimate displacement of a greater amount of open wire plant than could be released if the cable

were installed on any other route; furthermore, the plant which can be released is in areas subject to snow and ice storms and is, therefore, relatively more expensive to maintain than that over more southern routes.

Transmission Considerations

IN planning present day transcontinental facilities, consideration has to be given to providing adequately not only for a high standard of message circuit transmission but, in addition, for program transmission, telephotograph and telegraph transmission, and for the possibility of demands for further improvement in performance for these services in the future. From these standpoints, type-K carrier facilities are well suited for use on this project. This type of facility, with a velocity of transmission of about 100,000 miles per second, stabilized feedback amplifiers, and other desirable transmission design features, provides clear and faithful transmission over long distances. Furthermore, its application is particularly economical in this case, where a large number of long circuits, many of them over 1,000 miles in length, are involved.

The first 12-channel type-K carrier systems were placed in commercial service between South Bend, Indiana, and Toledo, Ohio, in 1938, using nonloaded conductors in two existing cables. In the succeeding years, type-K systems have been applied in many other sections of the plant; and, since they have proved to be excellent from the standpoint of both transmission and operation, they are expected to be highly satisfactory for the transcontinental cable.

Transmission features similar to those of the type-K system are also afforded by the type-L, or coaxial, system, but this latter system is not yet available for use over the great distances involved in the present project.

Through the Old West

FROM Omaha, the cable route selected is across the Nebraska prairie, past Lincoln, the state capital, thence along the Platte River near the old Oregon Trail through Grand Island, Kearney, North Platte, and Ogallala,

NO ROCK HERE

The earth auger tests the soil to the depth which the plow will penetrate

where it leaves the river, and then through Sidney over the grassy plains to Cheyenne, a distance of 500 miles. Cheyenne's elevation is 6,000 feet above sea level and 5,000 feet above Omaha.

From Cheyenne to Denver, about 100 miles south, the cable route is through prairie country, decreasing in elevation from 6,000 feet at Cheyenne to 5,000 feet at Denver.

THE region between Cheyenne and Laramie, a distance of 45 miles, varies in elevation from 6,000 to 9,000 feet, and is subject to sudden blizzards and heavy snowfalls accompanied by high winds. The cable route between these points parallels the Lincoln Highway (U. S. 30), which is kept open during the winter. West of Cheyenne the soil becomes increasingly rocky, and some blasting through rock for short distances is required in the section over the Sherman Hill Divide. This is the highest point on the cable, nearly 9,000 feet above sea level.

From Laramie the route bears northwest, following in general the old Overland Trail to swing around Elk Mountain and then parallel the highway westward through Rawlins, over the Continental Divide at Creston, elevation about 7,000 feet, through Rock Springs, Green River, and Fort Bridger. Here it again meets the Oregon Trail, then goes through Evanston and Castle Rock. In general, the land is rolling, covered with sage and greasewood. At this point the route turns to the southwest through mountainous country to Coalville, and thence to Salt Lake City, a total distance from Laramie of 378 miles.

The mountainous country between Evanston and Salt Lake City was the last obstacle which the Mormons had to surmount before arriving at the Salt Lake City area which had been chosen by Brigham Young as a site for the future Mormon state of Deseret. It is also an obstacle for the cables, and intensive field work, guided by detailed aerial surveys, has been required to obtain a satisfactory route. The cables will enter Salt Lake City a short distance from Emigrant Canyon, down which Brigham Young led the Mormon Pioneers in 1847, and at the mouth of which took place the dramatic scene where he pointed out their future home and said "This is the place."

THE route from Salt Lake City to Wendover, Utah, skirts the southern edge of Great Salt Lake, turns slightly to the northward to avoid a range of mountains, and traverses the mud and salt flats of the Great Salt Lake Desert before reaching Wendover, a distance of 124 miles.

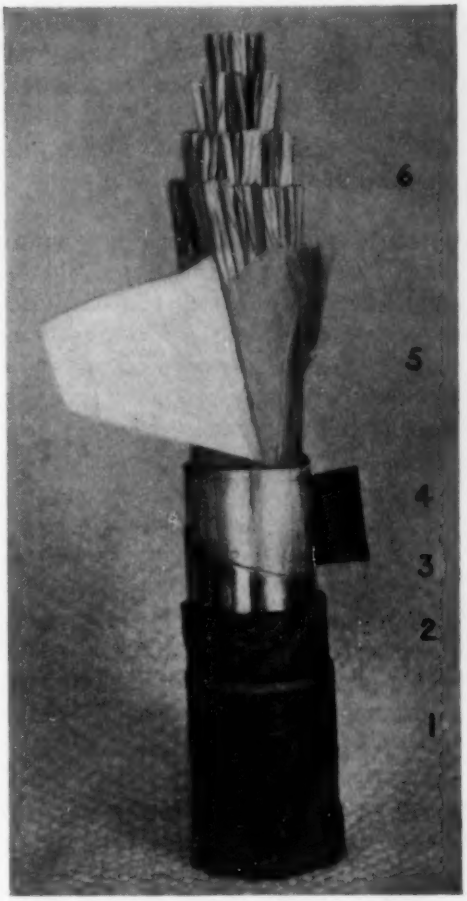
Great Salt Lake is the only remnant of an ancient inland sea. The slope of its shores is very gradual, so that a small increase in the water level will greatly increase the size of the lake. Water level data on the lake have been kept for only about 35 years, but it appears that the level has been steadily decreasing in the last ten years, because of greater consumption of water for irrigation purposes from the rivers which flow into Great Salt Lake. The cable will be placed above the highest water level which the lake has reached during the period studied. The mud and salt flats stretch east of Wendover for about 40 miles and are practically

level. They are flooded during certain periods with several inches of water. However, at times the surface is dry, and it is planned to plow in the cables during such periods.

From Wendover the cable route will cross the plains and plateaus of Nevada, including a few minor mountain ranges, on a fairly direct line through Elko and Reno. West of Reno the route crosses the Sierra Nevada near Donner Pass, and continues down the western slope to Sacramento, a total distance from Wendover of 483 miles. The Pacific Company has made extensive use of aerial surveys to guide the field work in the selection of a suitable route through this territory, particularly the difficult mountain terrain. The heavy snowfall in this region is expected to be an obstacle to maintenance work, and for this reason the cable will follow existing highways in the higher and more rugged sections.

Cable Details

THE detailed arrangements of the transcontinental cables for the operation of type-K carrier systems are essentially the same throughout the length of the route. One cable contains, in various sections, 54 to 88 pairs of paper-insulated 19-gauge conductors surrounded by lead sheath over which is placed a steel tape and jute and other protection. This cable is used primarily for one direction of carrier transmission. Certain of the pairs are loaded for use as voice-frequency plant maintenance circuits or, in some sections, for message circuits between intermediate points. The second cable, of similar construction, contains an equal number of conductors



CONSTRUCTION OF THE CABLE

This specimen of a typical section of one of the twin cables consists (reading up from the bottom) of: 1, jute protection; 2, thermoplastic protection; 3, steel "gopher tape"; 4, lead sheath; 5, double paper wrapping of core; 6, the conductors

for the opposite direction of carrier transmission and varying numbers of loaded conductors. In some sections, where a sizable number of voice-frequency circuits are required, this cable may be quadded.

Some 1,500-foot lengths of cable were used in the first sections plowed in. In general, long pieces of cable can be buried more economically than

short lengths. Accordingly, trials of 3,000-foot lengths were made, and since it was found that these could be satisfactorily handled, 3,000-foot lengths are now generally being supplied and placed.

WHILE the cable is being manufactured, great care is taken to avoid deviations from uniformity in the electrical characteristics of the conductors. When it is plowed into the ground, it is lubricated and its tension regulated to minimize physical deformation of the cable, so that the electrical characteristics of the cable in place will be as close as possible to those desired. In spite of these precautions, however, experience has shown that there will be residual small deviations in the characteristics of the cable conductors which, if permitted to remain unreduced, would have a serious effect on the operation of type-K carrier systems. This effect would show up principally as crosstalk between the channels of paralleling systems.

These deviations are reduced when the cable lengths are spliced together. The number of times one pair lies adjacent to another in the completed cable is also controlled. The splicing, a most important factor because of the high frequencies involved, is carefully carried out in pre-arranged patterns, and electrical tests are made to check the results as well as to contribute to the advance of the technique.

In order to obtain warning of cable damage, and to minimize the effects of this damage, it is planned to place the cables under permanent gas pressure, a method which has come into general use in the toll cable plant over the last decade and has been found extremely effective.

The gas will be dry nitrogen, and will be maintained at a pressure of about nine pounds per square inch. Electrical contactors which close and give warning if gas pressure falls at any point, due to damage to the sheath, will be placed along the cables at intervals of about 10,000 feet, and valves for testing the pressure will be located every 3,000 feet.

The valves will be above ground, and connected to the cable by means of lead pipe, which will be fastened to creosoted stubs set in the ground deep enough to be anchored firmly and projecting above ground far enough to be readily seen above snow and growing crops. Other stubs will be placed at various intermediate points, and all of the stubs will serve as markers of the cable route.

Once a cable is plowed in, about thirty inches below the surface of the ground, it would appear that it would be safe from any interference for a long time. Facts about buried cable indicate that, even after the cable is installed, there are a number of sources of potential interference which must be reckoned with.

Prevention of Corrosion

CORROSION of cable sheath, often referred to as electrolysis, is caused by a transfer of current between the cable sheath and earth, or by direct chemical attack. For example, if a cable traverses two areas having a difference in potential, the fact that the cable sheath is a conductor will allow current to flow from the high to the low potential area along the cable

MEASURING EARTH RESISTIVITY

The kind and extent of protection against lightning provided for the cable along different sections of the route largely depends on the results of field tests such as that shown here

sheath. The point or points at which this current leaves the cable sheath will show pitting or corrosion, which is the visible mark of electrolytic action. If not checked, this will eventually eat through the sheath.

Information has been obtained, therefore, concerning telephone experience in localities along the route, and the operators of gas, oil, and water pipe lines that parallel and cross the route have been interviewed regarding their experience. If an area requires that special measures be taken to prevent corrosion, these measures are worked out on the basis of all data available, and coördinated with pipe lines and other structures which either suffer from or are potential causes of corrosion.

For example, it was found that the area between Overton and Ogallala, Neb., a section of about 120 miles, is particularly subject to corrosion. The pipe line companies in this section have had experience in combating this situation, and their problems and methods were examined in detail. In the case of one bare iron pipe line, a system of corrosion protection called "forced drainage" is being used. A number of windmill- and gasoline-driven generators are used at rather short intervals, each of which draws a current of a number of amperes from the pipe line and returns it to a ground made up of buried pipe some distance away. This keeps the pipe line at a negative potential with respect to ground. The distribution of

current around these grounds was measured, and as a result it was found that it would be desirable to maintain a separation of about a mile between the pipe line and paralleling cable equipped with ordinary jute covering.

It was not possible to maintain this distance from all pipe lines through the Overton-Ogallala section, however, and another method of protection was adopted. This consists of an insulating thermoplastic and thin impregnated jute covering for the cables, in place of the usual heavy jute covering. The thermoplastic layer is about 1/16 inch thick and is composed of rubber, asphalt, and inert filler. Tests have not been completed over the entire route, but it is likely that the thermoplastic covering will be used to a large extent across Wyoming, Utah, and Nevada.

Possible corrosive effect on cable sheath of the soil and water in the flats of the Great Salt Lake Desert was first considered in 1930 when for test purposes a number of sections of various types of cables which were employed in underground construction were buried at different points in the salt marshes and flats east of Wendover. These cables were recently dug up, and found to have been little affected by corrosive action of the soil.

Protection against Lightning

LIGHTNING can damage buried as well as aerial cable. When lightning strikes the earth at any point, a momentary but tremendous current flows away from that point in all directions through the earth and all other possible paths. If the stroke occurs to or near a buried cable, the cable will, therefore, carry away a large proportion of this current in both directions. The higher the earth resistivity, the greater is the distance along which this current will be carried by the cable sheath. If the current flowing along the sheath is large enough, the drop of potential due to the resistance of the sheath may result in building up sufficient voltage between it and the wires inside to break down the insulation and in some cases cause holes in the sheath so that the cable has to be dug up and repaired. The insulation may be punctured in various places over an interval of several miles, or the damage may be confined to one location. Probability of damage to a buried cable can be reduced by decreasing the resistance along the sheath.

The relationship between earth resistivity and the geological structure of the United States has been the subject of considerable study by the Bell System. From this study a very good general knowledge of the earth resistivity which may be expected in any area has been obtained. By means of these data on earth resistivity, and information obtainable from iso-ceraunic charts, which show the frequency of thunder storms in all sections of the country, it is possible to predict in a general way the relative amount of trouble from lightning which might be experienced with buried cable in any particular region.

The engineering work on the transcontinental cable, accordingly, included a careful investigation of the route from this standpoint, with the help of these charts and of accurate field measurements of the earth resistivity at intervals along the route. Based on the data thus obtained, pro-

AN "UNATTENDED" REPEATER STATION

This structure at Durham, Wyo., is typical of those built at intervals on the cable route. They house the delicately attuned equipment required to amplify the currents as they become attenuated along the line. The apparatus is designed to operate for considerable periods without direct attention, control circuits to the nearest attended station indicating any need for testing or trouble clearance

tective arrangements against lightning damage were designed for the cable.

These arrangements vary in the different sections, but include such plans as increasing the insulation between the core and the sheath by doubling the thickness of the paper wrapping of the core, placing copper shield wires in the same trench with the cables, or adding copper wires between the sheath and the core, and combinations of these measures. For example, in a section east of Cheyenne, and from Cheyenne to Denver, shield wires are buried in the trench with the cables. Going west from Cheyenne the earth resistivity increases rapidly, reaching the highest value on the entire route over the outcropping granite formations of Sherman Hill Divide. Between Cheyenne and Laramie, therefore, various combinations of the preventive measures are being used, all three being employed over Sherman Hill Divide.

Gophers Attack Buried Cable

WHILE it might not seem that an asphalt-coated, jute-wrapped, lead-covered cable would make a palatable meal, the gophers and prairie dogs in many mid-western states feel otherwise about it. It has been found that if the opportunity is presented, they will attack the covering vigorously, finally chewing through it to the conductors and thus causing service interruptions. In cables maintained under gas pressure, puncturing the sheath would of course release the gas. Studies of the habits of the pocket gopher, for instance, have

shown that he operates in a zone from 12 inches to 48 inches below the surface of the ground, and prefers soil which has been loosened, as by plowing. To prevent trouble from this source, a steel tape about an inch wide and $\frac{1}{100}$ inch thick, referred to as "gopher tape," is being placed around each of the transcontinental cables, directly over a paper asphalt pad wrapped around the lead sheath, during manufacture. The protective jute or thermoplastic covering is placed over the gopher tape.

Repeater Stations and Equipment

THE use of K carrier telephone systems utilizing frequencies up to 60,000 cycles per second requires repeaters spaced at intervals of about 17 miles to compensate for the transmission loss experienced at these frequencies. Between Omaha and Sacramento, there will be a total of 100 repeater stations, 18 of which are classified as main stations and 82 as auxiliary stations. The main stations, many of which are already repeater stations on open wire lines, will serve as points from which testing and trouble clearing will be directed.

In general, the main stations will be attended, the auxiliary stations unattended. These auxiliary stations have been designed to house the necessary equipment, including repeater, testing, power, heating, and ventilating apparatus. Where the climate is relatively mild and electric power is available, electric heaters will be used to maintain a temperature of at least 40 degrees in winter. Electrical ventilating equipment will operate automatically in hot weather to aid the efficient operation of the equipment. The auxiliary stations to house this equipment are 24 × 24 feet in size.

For use where commercial power is not available, or a higher heating capacity is required, a new oil-burning plant has been engineered. This will require a building 20 × 40 feet in size. The six auxiliary stations between Omaha and Grand Island will be 24 × 24 feet in size, but the stations from Grand Island to Salt Lake City will be of the larger size to accommodate the oil heating plant. Beyond Salt Lake City, the plans for the auxiliary stations have not yet been completed.

THE locations of the stations are chosen carefully to be accessible from good roads and as close to existing sources of electric power as practicable and, at the same time, to be consistent with the desired repeater spacing. The power plant, being vital to the operation of the station, is engineered to be as free as possible from danger of interruption. In all stations, large size rubber jar batteries are used which will provide a considerable initial reserve. Where commercial power is not readily available, economic studies are made to see whether it would be better to pay for the extension of power lines, or to provide engine-driven power plants.

Where commercial power cannot be obtained economically, twin engine-driven d-c generators, arranged to operate automatically and alternately, are provided. The accessibility of the station and other factors determine whether or not emergency engine-driven charging equipment will be provided. Where a number of stations are easily accessible, it is often pref-

erable to provide a few portable emergency engine-driven alternators which can be readily moved to any station.

The Pacific Telephone and Telegraph Company has a unique problem of snow sometimes as much as 25 or 30 feet deep on the cable route over the Sierra Nevada near Donner Pass. It is considering constructing two-story stations, with first and second floor and roof entrances, so that maintenance men can get into them, whatever the depth of the snow. Oil heat is also being considered for these stations.

THE emigrants, intensely individual and with a restless urge to move westward, nevertheless retained a strong desire to maintain communication with people behind them. This desire was first met by the overland mail and the Pony Express. Later, the telegraph, the railroad, and finally the telephone came into being. Utilizing these instruments for communication, these individuals and their descendants became welded into a strong and unified nation.

Today we are engaged in a supreme effort to arm and defend that nation. More transcontinental communication facilities are urgently needed to help direct this effort.

That plow train, moving steadily westward, with all the research, experience, and modern engineering of the Bell System behind it, is forging a vital, powerful link in the machinery for the defense of America.

APPROACHING MOUNTAINOUS COUNTRY

This is typical of much of the terrain which the cable crosses. The view here is westward in the direction of Evanston, Wyo.

THE 1941 CONVERTIBLE BOND ISSUE

Funds to Provide for Bell System's Construction Program Obtained by Offering of $233,584,900 of Fifteen Year Three Per Cent Convertibles to 631,030 Holders of A. T. & T. Stock

By JAMES F. BEHAN

By means of a prospectus dated July 16, 1941, the American Telephone and Telegraph Company offered to stockholders for subscription at par, without underwriting by bankers, $233,584,900 Fifteen Year 3% Convertible Debenture Bonds Due September 1, 1956, convertible into stock after January 1, 1942, at $140 per share. The bonds will be convertible through 1954 unless previously called for redemption, but the conversion price and the number of shares issuable on conversion are subject to adjustment in certain events. Under the terms of this offer, which was in the ratio of $100 principal amount of bonds for each eight shares of stock held, 631,030 stockholders of record became entitled to receive 18,686,794 subscription rights, one for each share held.

"One of the biggest jobs that Wall Street's trading machinery has tackled in a decade or longer got started Wednesday." Such was the comment of the *Wall Street Journal* on the start of market trading in the rights on July 16. For the Company, however, the issue of the offering prospectus, which permitted trading in rights to begin, represented the culmination of weeks of work.

Tentative preparations for a convertible bond offer had been started in the Comptroller's, Legal, and Treasury Departments and in the Secretary's office during the early spring. The first concrete step, however, was the submission of a proposed Proxy Statement to the Securities and Exchange Commission early in May, 1941, to provide for a possible meeting of stockholders for the purpose of authorizing such an offer. Thereafter, it was a question of working early and late on the mass of detail involved in bringing the project to a successful conclusion. The rigid time-table of printings, SEC filings, executive actions, and stockholder mailings was no respecter of persons. On many occasions lights were kept burning long into the night at 195 Broadway, such as when the Comptroller and those associated with him in preparing the Registration Statement and Prospectus were faced with an important date in the SEC filing schedule.

At the annual meeting of stockhold-

SPECIAL TRAINING

The Treasury Department's supervisor of methods explains things to one of the groups receiving two weeks of preparatory instruction

ers in April, President Gifford had announced that, due to the growing demand for telephone facilities resulting from the national defense program, construction requirements in the Bell System for 1941 would approximate $400,000,000 and that some financing would be necessary to meet these requirements. On May 21 the Board of Directors took action, recommending that the financing be undertaken through a convertible bond offer and calling a special meeting of stockholders for June 25 to act on the recommendation. Nearly two-thirds of the stockholders were represented at this meeting, either in person or by proxy, and over two-thirds of the outstanding stock was voted in favor of the offer.

SECURING the return of sufficient proxies to be sure of the necessary two-thirds favorable vote of the stock required to authorize the proposed issue presented somewhat of a problem, not because any appreciable number of stockholders objected to the Company's financial program but because people in general—and A. T. & T. stockholders constitute a good cross-section of people in general—are apt to postpone or overlook action on propositions put up to them in proxy statements, if they appear at all complicated. However, stockholders responded promptly to telephone calls about having their stock represented at the meeting and also to a short follow-up letter, which President Gifford sent out about two weeks after the proxy statements were mailed. This special mailing, which involved the printing, numbering, and addressing of a duplicate set of 630,000 proxy forms for the entire stock list, established a time record for that type of work. The mailing was in the post office five days after executive decision to make it. Shares voted against the issue added up to less than one per cent of the stock outstanding.

An unexpected misconception of the

EARLY ACTIVITY

This was one of three groups which enclosed the Prospectus and President Gifford's letter for mailing to stockholders last July

Company's proposal developed in the minds of quite a number of stockholders at the time proxies were solicited, and was encountered again during the subscription period. The fact that the management was recommending an issue of *convertible* debenture bonds led some people to think that they would have to convert their present shareholdings of stock into the new bonds. Naturally, they were not in favor of doing this; but later one or two stockholders did go so far as to send stock in for exchange, in the belief that the Company desired it.

IN response to an inquiry at the special meeting of stockholders as to why the management had not decided on an offer of stock instead of convertible bonds, President Gifford stated:

"We anticipate that we shall need a great deal of money this year and next year and probably the year after that. We don't try to go too far into the future. This issue, if successful—and of course it will be—will give us $234,000,000, roughly, in the fall.

"Now, if we want some more money next year, and we will want more at the rate we are going, if the convertible bond issue is used, we shall get, if the conversion rate were $150—it hasn't been fixed yet—another $100,000,000 next year or the year after, or whenever the conversion privilege was exercised.

"In other words, we would have raised not only $234,000,000 but something over $300,000,000 by this method. If we raised it all by a stock issue at one time, we would have this larger amount of cash to

carry with no return on it and we would receive it sooner than we need it."

BECAUSE of its size and the number of stockholders involved, the issue attracted wide attention throughout the financial community and the three per cent interest rate, coupled with the fifteen year maturity, was generally commended. The following comment in the *New York Journal of Commerce* of June 26, 1941, was typical of early predictions of success for the issue: "While investment bankers hold firmly to the more or less occupational thesis that every issue should be underwritten, it is readily conceded that in the case of Telephone it matters little to the company."

Nevertheless, in the light of the uncertain times which the nation faced in July, and still faces, no one could feel completely sure about an offer of bonds to stockholders which necessarily had to remain open for subscription for a month and a half after the terms were set. Fortunately, the market quotations for stocks as well as for bonds held moderately firm during this period. The price of A. T. & T. stock slid off a bit under pressure of the new financing, but rights to subscribe for the Convertibles never sold on the New York Stock Exchange below $1\frac{7}{32}$ ($1.21875) and the closing price on the expiration date, August 29, 1941, was $1\frac{18}{32}$ ($1.5625), the high for the period. Since eight rights were required to subscribe for each $100 of bonds, these prices for rights represented an equivalent low for the bonds of $109\frac{3}{4}$ and an equivalent high of $112\frac{1}{2}$. At $109\frac{3}{4}$ the investment

SUBSCRIBING IN PERSON

The Treasury Department established a temporary counter in the lobby of the A. T. & T. building for the convenience of people wishing to make subscription personally

yield on the bonds to the earliest call date at par in 1953 was 2.08 per cent.

Under these price conditions, a full subscription for the offer was assured if stockholders took care to exercise their rights or to sell them in the market for others to exercise within the allotted time. As the expiration date approached, this remained the only uncertainty. Not until the final closing, however, could the Company determine to what extent stockholders might be overlooking the value of their rights.

95.4 Per Cent Subscribed

UP to Wednesday night, August 27, subscriptions for only $65,000,000 of bonds, or 28 per cent of the amount offered, had been received. By the close on Thursday but 4 per cent more had come in. This meant that some $135,000,000 additional had to be subscribed by Friday, the final day, if the offer was to be as much as 90 per cent taken.

It had been publicly announced the day before that subscriptions placed in the mails in continental United States up to midnight on August 29 would be accepted if they conformed to the terms of the offer as stated in the Prospectus. How many subscriptions would be in transit, unreceived, when the offices closed at midnight Friday, it was not possible to say; but smiles were plentiful around the Treasury Department that evening, when the day's bank deposits were totalled up and found to approximate $139,000,000.

After everything had been received and accounted for and all pending cases disposed of, the books showed

Principal amount of bonds offered		$233,584,900
Amount of bonds subscribed		$222,745,200
Per cent subscribed		95.4%
Amount of bonds unsubscribed		$10,839,700
Shares of stock outstanding on record date		18,686,794
Rights required to subscribe for $100 of bonds		8
Price range during subscription period:		
Stock—Ex Rights—	High	155⅞
	Low	152
Rights—	High	1.5625
	Low	1.21875
Bonds—	High	112⅝
	Low	110
Stockholders on record date		631,030
Approximate number of subscriptions *		116,000
Average principal amount offered per stockholder		$370
Average principal amount per subscription *		$1,921
Subscription warrants issued, including transfers		1,030,000
Incoming Bond Issue letters		170,000
Bond Issue telephone calls		17,000

* In these figures a group subscription by a bank or broker for its customers is counted as one subscription since it was recorded in the bank or broker's name.

$222,745,200 of bonds subscribed for, representing 95.4 per cent of the amount offered. This result stamped the financial operation as a complete success.

Some interesting statistics are shown on the opposite page.

It would be natural to ask why only 95.4 per cent of the convertible bond offer was subscribed; why stockholders allowed 867,000 rights, with a market value of roughly $1,350,000, to go unused, notwithstanding the demand in the market and the high closing price. Current unfamiliarity with subscription rights is believed to have been the chief reason for the amount left unsubscribed—although correspondence after the close of the issue indicated that "absence from home" because of vacations, illness, etc., was also a factor. Eleven years had elapsed since the last subscription offer by the Company, with the result that some 380,000 stockholders, representing 60 per cent of the total, had never before had A. T. & T. rights to deal with.

Pursuant to a supplement to the Prospectus, the Company has sold the unsubscribed portion of the issue, amounting to $10,839,700, on the various stock exchanges through member firms of such exchanges, who received for their services only the regular brokerage commission.

Bankers Trust Co. Aids Stockholders

In previous issues of stocks or convertible bonds, stockholders could buy and sell rights through the Bell Telephone Securities Company. Similar arrangements made for this issue with Bankers Trust Company adequately replaced these facilities. In fact, transactions handled for stockholders by Bankers Trust Company exceeded those handled by the Bell Telephone Securities Company in past issues, as indicated in the table below.

These figures demonstrate the unquestioned need for the provision of some such facilities for stockholders. An offering on a one-to-eight basis meant that 250,000 stockholders, scattered throughout the country, would receive fractional warrants only (that is, warrants for less than the number of rights required to subscribe for a $100 bond), and that 325,000 additional stockholders receiving full warrants would also receive fractional warrants which they would have to sell or match up with additional fractions if they were not going to allow them to lapse.

The Bankers Trust arrangement, and the modest agency charge of five cents per right for buying and selling made by the bank, proved entirely satisfactory to stockholders. The bank's personnel could not have been more

	Rights Bought	*Rights Sold*	*Total Transactions*
Bell Telephone Securities Company:			
1928	234,000	341,400	121,700
1929	275,600	927,400	154,500
1930	181,000	513,800	156,100
Bankers Trust Company:			
1941	303,000	2,352,500	216,700

enthusiastically coöperative than they were with the Company's bond issue organization. More than 200 of the bank's employees received advance instruction so that they could take part in the work whenever the daily volume of transactions required it, and the entire ninth floor of the bank's head office building at 16 Wall Street, along with special counter space on the ground floor, was given over to the rights job. According to an article which appeared in the Bankers Trust magazine, *Pyramid,* they developed unique names for some of their specialists. File girls wearing aprons became "Flower Girls." Girls cutting checks apart with knives became "Check Butchers." Men rubber-stamping warrants became "Pounders." Girls photographing warrants became "Shutter-Bugs," and the man in charge of supplies became "The Green Grocer." President S. Sloan Colt's message in the *Pyramid,* reprinted below, indicates that almost everyone in the bank was in one way or another affected by the operation.

"We are within four days of the completion of the rather unusual piece of work which Bankers Trust Co. has had the opportunity of doing for the Stockholders of the American Telephone and Telegraph Company in acting as Agent for buying and selling rights issued in connection with the recent bond issue. As the PYRAMID goes to press tonight, I want to congratulate those who planned and carried out this unique service with such efficiency and enthusiasm. I have heard nothing but the most favorable comments from the public whom we have served.

"Nearly everybody in the bank was directly or indirectly affected by this operation and I want to

TELEPHONE TRADERS AT BANKERS TRUST CO.
These men kept in touch with the market in rights in New York and other cities

PERMANENT RECORDS

Micro-film cameras were used to photograph documents covering transactions handled at Bankers Trust Co. Similar equipment was used in Treasury Department operations at 63 Wall Street and 195 Broadway

thank the entire staff for the splendid coöperation which made possible the success of the undertaking."

As well as being of convenience to stockholders without banking or brokerage facilities, the arrangement with Bankers Trust Co. helped solve the problem of how to dispose of the rights of nationals of "blocked" countries. At the time of the offer, 2,100 of the Company's stockholders resided in blocked countries into which it was illegal to send the rights, and another 1,300 resided in other places outside of continental United States where it would have been impracticable to mail warrants because of the time factor. To protect their interests, all these stockholders were sent special notices stating that their rights would be sold for their accounts through Bankers Trust Co. on the expiration date, if they had not previously arranged with the Company for the exercise or disposal of the withheld warrants.

Approximately 116,500 rights were delivered to Bankers Trust for sale for stockholders' accounts under this arrangement. A similar disposal was made of warrants for 4,100 rights which for one reason or another were not deliverable to domestic stockholders. In the case of nationals of blocked countries the proceeds had to be credited to blocked accounts in domestic banks for such final disposition as the laws and regulations of the United States might permit.

One of the early concerns of the Treasury Department was settled by

the discovery in May that 36,000 square feet of excellent office space for the bond issue work could be rented in an office building at 63 Wall Street. This space, located on three adjoining floors, was already equipped with Holmes-protected vaults and it was otherwise ideally suited to house the large organization which would be needed. Additional space was also required at 195 Broadway, and a special subscription counter was set up in the lobby of the building, where, of course, the larger subscriptions were filed by bankers and brokers. As in past offers, subscriptions were also received at the Treasurer's office in Boston.

Equipment and Organization

To equip the temporary quarters, some 2,000 pieces of furniture and miscellaneous office equipment were needed, much of which was rented, or borrowed from other companies.

The growing scarcity of materials and equipment presented a problem which had not been encountered by the Department in organizing for previous offers to stockholders. This meant anticipating requirements further in advance, and more careful planning all around.

For example, the paper required for the Prospectus amounted to more than 150,000 pounds—enough to fill five freight cars. The mills which specialize in the type of paper to be used were unable to supply this large quantity within the time limits available, and it was necessary to have the paper manufactured to a special formula by a regular book-paper mill. More than 650,000 copies of the Prospectus were printed on the first run. To meet the schedule of six days for the printing and delivery of such a large quantity, the job had to be done by two printers and involved the use of 17 presses. It was the same story for the Prospectus envelopes. Since no one manufacturer could deliver the required 630,000 envelopes when needed, the order was placed with three envelope manufacturers, and three different grades of paper had to be used.

Manufacture of the subscription warrants to be mailed to stockholders presented another interesting problem. More than a million warrants were needed in the initial order, and 14,500 pounds of special paper had to be milled in advance for this purpose. For numbering and final printing of terms on the warrants, it was necessary to install at 195 Broadway eight printing presses and one power cutter. These presses were operated from 16 to 20 hours a day for a period of eight days.

Visitors to the temporary quarters at 63 Wall Street were particularly interested in the number of stages through which bond subscriptions passed. By reason of the volume and nature of the work, a step-by-step process was used which involved a dozen or more separate operations. During one of these steps a "micropicture" of each subscription and accompanying remittance was made by Recordak for record purposes. This machine took small pictures on a continuous film, and had self-contained equipment for projecting full-size enlargements of the material photographed.

A favorite picture to show visitors

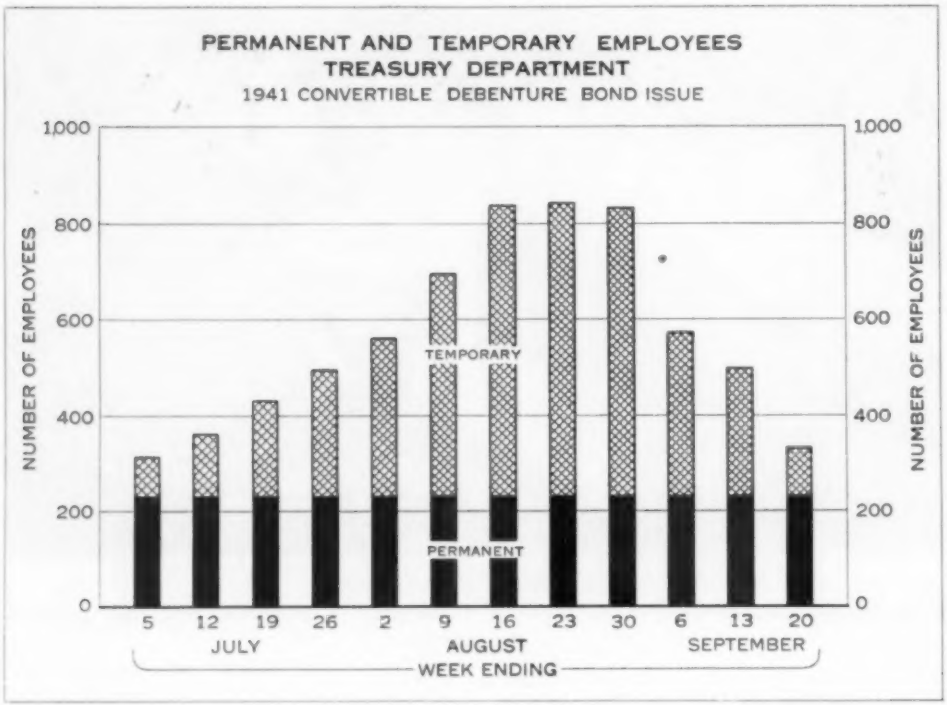
TEMPORARY PRINT SHOP

These presses were installed in the A. T. & T. building in connection with final printing of the warrants

in demonstrating this equipment was one of a cashier's check which had been received from a small country bank to cover a $700 subscription but which, by a slip of the check-writer, had been written for $1,000,700. Needless to say, the check was returned for correction. A large number of checks received, many from banks, had to be returned because of being incorrectly written or unsigned. If one of the amounts on a check was correct, however, and the other was not more than $200 or $300 off, the check was put through for clearance with a certification by the Company as to the correct amount.

Because the long-distance wires are important to the speeding-up of the nation's defense program, the communications bureau at 63 Wall Street, which was receiving about a thousand letters per day to answer, did not make use of out-of-town telephone calls as frequently as it otherwise would have done. All told, telephone calls about the offer, both incoming and outgoing, exceeded 17,000. Some were quite amusing. In one instance, where a telephone call was put through to an out-of-town bank to inquire if it would honor an unsigned check which it had mailed in as a subscription payment, an urgent request came back to deposit the check by all means, because it was intended to cover a subscription for the president of the bank and it would be very embarrassing to the cashier to have the check returned for correction. The telephone, in many cases, offered the only way to get a subscription matter straightened out in the time available.

All together, some 430,000 temporary bonds were issued to cover subscriptions received. Of these, ap-



proximately 134,000 pieces, representing $131,000,000 in bonds, were delivered over the counter to banks, brokers, and other large subscribers direct from space temporarily assigned to the Department in the offices of the City Bank Farmers Trust Co., Trustee of the issue; and deliveries of another $19,000,000 of bonds were made over the counter at 195 Broadway. The remaining bonds, consisting largely of $100 and $500 denominations, covering some 110,000 subscriptions, were sent out by registered mail. A new process was developed for addressing the envelopes used for this delivery, which consisted of cutting and pasting a carbon copy of the subscription register on the mailing envelope to indicate the subscriber's name and address and covering this with a transparent piece of tape. More than nine miles of this protective covering were used before the last bond was on its way.

IT is said around the Treasury Department that almost anything can happen during a subscription offer. The idiosyncracies of stockholders which come to a focus on the Company at such times provide many surprises. For example, one subscriber to this issue sent in only the lower half of her warrant, which provided for the subscriber's signature, having torn off the upper half, which showed such essential information as the number of rights it represented and the name of the holder. She later explained by telephone that she wanted to keep this upper half as a record of the transac-

tion and as a receipt. Strange things happened in the bond issue organization itself, such as a temporary employee's getting lost and going to work in the wrong section for one supervisor while another supervisor was anxiously awaiting her arrival. But incidents of this sort were of no importance compared with the balancing out to the penny of the bank account through which $223,000,000 in subscription remittances had been cleared, or with the full accounting for more than 430,000 bearer bonds upon completion of bond deliveries.

The out-of-pocket cost of the bond issue to date, excluding the exchange of temporary for definitive bonds, to take place next year, has been approximately $1,000,000. Much of this expense, such as the Federal stamp tax of $257,000 and the fees for registration, listing, and authentication of the bonds, would have been the same for a public offering of the bonds through underwriters.

OUT of a total of 625 employees in the bond issue organization at the peak of the work, 496 were temporary employees, the balance comprising regular employees of the department or employees borrowed from other Bell System organizations—of whom there were seventy-six. To secure the required number of temporary employees, over 1,500 applicants were interviewed. Of the number engaged, 283 were either college or post-graduate students representing 105 colleges and universities. In addition, 50 high school and college instructors were engaged for the summer recess. These employees adjusted themselves to a new environment and to unfamiliar work in a most gratifying manner.

Most of the new people were given a short training course in order to familiarize them with the background of the Bell System, the bond issue organization, and the terms of the offer. In addition, certain groups were given specialized courses involving the handling of correspondence, the acceptance of counter subscriptions, the allotment and mailing of bonds and various machine operations. These training courses involved a total of 8,200 employee hours and without doubt helped the employees to adapt themselves quickly to the work.

In order to get a picture of the spirit and efficient operation of the bond issue organization it was only necessary to walk through the offices and see the interest which employees took in their assignments, although at times these had to be long and hard. Saturdays and Sundays were like any other days when there was work to do or a schedule to be met. It is not possible to speak too highly of the way in which both temporary and permanent employees applied themselves to the work or of the example set by their supervisors.

THE TELEPHONE AFLOAT

Through 24 Shore Stations on Our Coasts and Inland Waterways, More Than 3,000 Vessels Can Communicate Readily by Radio Telephone with the Bell System's Telephone Network Ashore

By GAIUS W. MERWIN

With more than 3,000 vessels equipped with radio telephones which have immediate access to the 23,000,000 Bell System and connecting telephones in the United States, the telephone afloat is indeed an important factor in the life of those who go down to the sea in ships. Ship telephone service has taken its place as a regular Bell service since its inauguration to ocean-going liners in 1929 and to smaller coastal and harbor vessels in 1934.

Today, due to the war, most of the liners which had been equipped with radio telephones are either serving as troop transports, are tied up idle at their docks, or have been sunk in the service of their country. Thus, telephone service to these large ships must wait until peace reigns again. On the other hand, telephone service to boats in harbors, along our coasts, and on the Great Lakes has continued its rapid growth, from the standpoint both of boats equipped and of number of messages handled.

Ship telephone service through the coastal harbor shore stations of the Bell and connecting radio telephone companies is available to ships in the coastal and inland waters of the United States.

Starting with the first Bell System coastal harbor radio telephone shore station, which was opened for commercial business at Marshfield, Mass., near Boston, on July 1, 1934, by the New England Telephone and Telegraph Company, a whole chain of radio telephone shore stations serving the nation has come into being in recent years. In addition to the Boston station, which serves New England waters, the Atlantic coast line is dotted with a series of stations which include New York (two stations), Wilmington, Norfolk, Charleston and Miami. Ships plying the waters of the Gulf of Mexico are served by shore stations at Tampa, New Orleans, and Galveston. Similar service is available on the Pacific coast, as ships can talk at any time to homes and offices through the shore stations located at San Pedro, San Francisco, Astoria, Portland and Seattle. Of these fifteen Bell stations, Wilmington, Charleston, Tampa, and Galveston started service in 1940, and an additional channel was

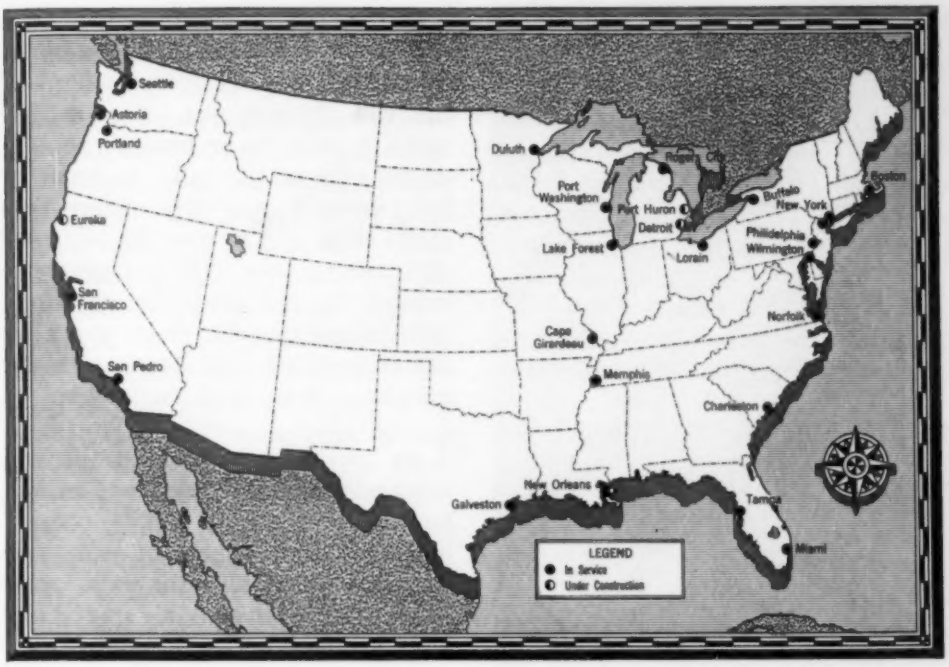


FIGURE 1

Shore stations of the coastal and harbor radio telephone service

also added to one of the New York stations last year. New stations at Astoria and Portland were opened in February, 1941, and others are under construction at Eureka, California, and at Detroit and Port Huron, Michigan.

Figure 1 shows the location of all these Bell radio telephone shore stations, and also shows those which have been provided by connecting radio telephone companies for serving boats on the Great Lakes and on certain rivers. These connecting-company shore stations are located at Buffalo, N. Y.; Lorain, O.; Rogers City, Mich.; Lake Forest, Ill.; Port Washington, Wis.; Duluth, Minn.; Philadelphia, Pa.; Memphis, Tenn.; and Cape Girardeau, Mo.

All these shore stations serve as connecting links between the land telephone lines and the various vessels as they ply the waters of our coasts and inland seas. A call from a boat goes by radio to the radio telephone shore station desired, where it is picked up and placed on the wire lines of the Bell System and its connecting companies, and the making of such telephone calls becomes as much a matter of daily routine as the land telephone service used every day.

Operation of the Service to Ships

FIGURE 2 shows the Wilmington transmitting station, and Figure 3 shows the Tampa receiving station, which are good examples of the more recent shore station installations. These radio telephone transmitters and receivers are connected by wires

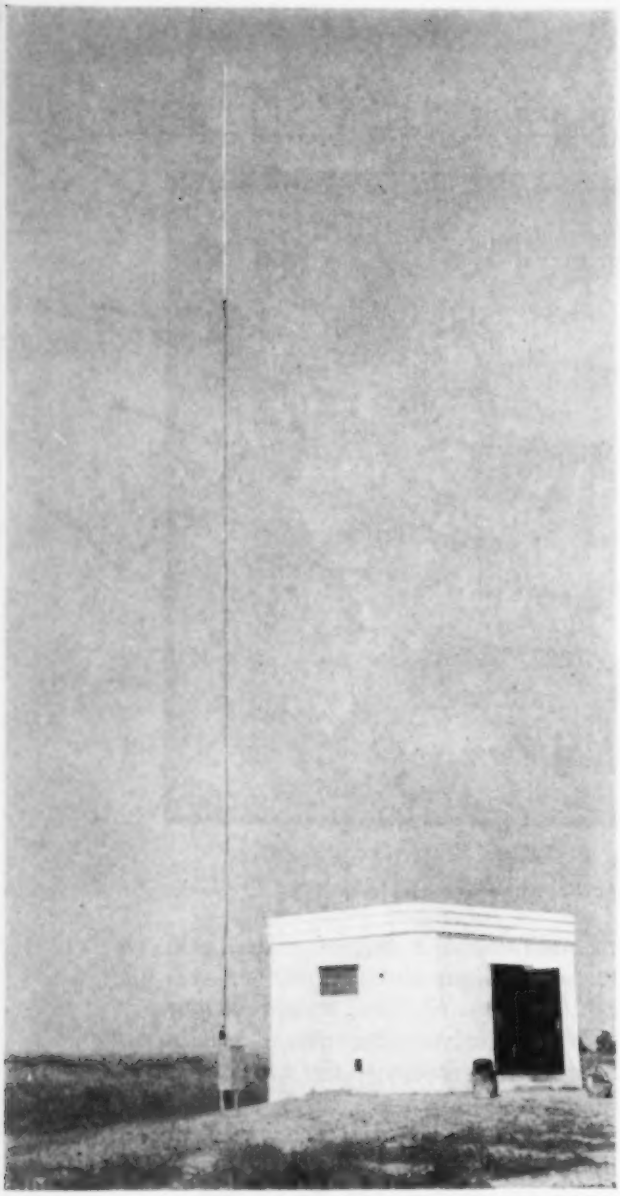


FIG. 2. *The radio telephone transmitting station at Wilmington, Del., for coastal and harbor service*

to the telephone company operating rooms.

Such radio equipment does not require constant attendance, but in many cases is remotely controlled from the telephone company's operating rooms, which may be miles away. To place a call from a land telephone, all that one has to do is to ask for the marine operator, or under certain conditions give the details of the call to the toll operator. The telephone company marine operators keep in touch with the various boats, and, in case one is not sure as to the location of the particular vessel desired, will place the call through the shore station which appears to be nearest the ship at the time of the call. In order to bring down the cost of providing service to ships and to give the best possible service, the calls are generally handled by regular traffic operators, with technical radio men always on call if anything goes wrong with the automatic features of the system.

THE operating facilities at the marine positions of the telephone switchboards are relatively simple, consisting of an arrangement of jacks and lamps associated with the radio transmitters and receivers. No special key shelf arrangements are required, except the provision of a dial where this is not already provided for other purposes.

Vessels may be equipped with selective signaling apparatus, which rings a bell on the ship when the shore station operator wishes to call it. Ships not equipped for selective signaling are called by name following the operation of the cord circuit ringing key at the marine position which transmits a distinctive attention signal For both selective and non-selective signaling, a boat will receive notification of a call only when its set is adjusted to the particular frequency of the radio terminal office which is calling. With the set so adjusted, a bell will ring on a ship equipped for selective signaling, and the attention signal followed by an announcement that a given ship is being called will be heard in the loud speakers of all ships not equipped for selective signaling.

The radio telephone sets used on

boats for talking with the shore are in all cases provided by the owners of the boats. More than 20 different concerns are building various types of boat sets, most of which vary from 10 to 100 watts in power. Some of these sets cost as little as $200 to $300 installed; although where boats need fairly long haul communication, the sets may cost $1000 or more, depending upon the type and power of the set, the number of frequencies available, etc. As shown by Figure 4, the smaller radio telephone sets do not take up much more room than a medium sized home broadcast receiver.

Actually this Western Electric set shown weighs 33 pounds, and is only about 13 inches in length—which is its greatest dimension. It is arranged for four different frequencies, so that without changing the crystals one can talk to two different shore stations, on the boat-to-boat frequency, and to the Coast Guard, which may be reached when assistance is needed. The hand telephone provided with the set has a press-to-talk switch in the handle. In a larger set such as shown in Figure 5 and having a power of 100 watts, space is provided for ten different frequencies, and voice-operated relays are included which eliminate the need for a press-to-talk switch. Figure 6 shows the ship telephone used as a part of this set.

Two classes of coastal and harbor radio telephone service are offered through the Bell System shore stations: general service and dispatching service.

General service covers random calls between any land telephone and any suitably equipped vessel or between two vessels. The rate for the radio link includes a connection with any telephone within the designated local service area of the radio terminal office, and in some cases within a certain zone along the shore. Where points on land outside this area are involved, an additional charge for the land portion of the call is added to the radio-link charge.

Dispatching service is intended for communication between vessels of one customer and one or more designated

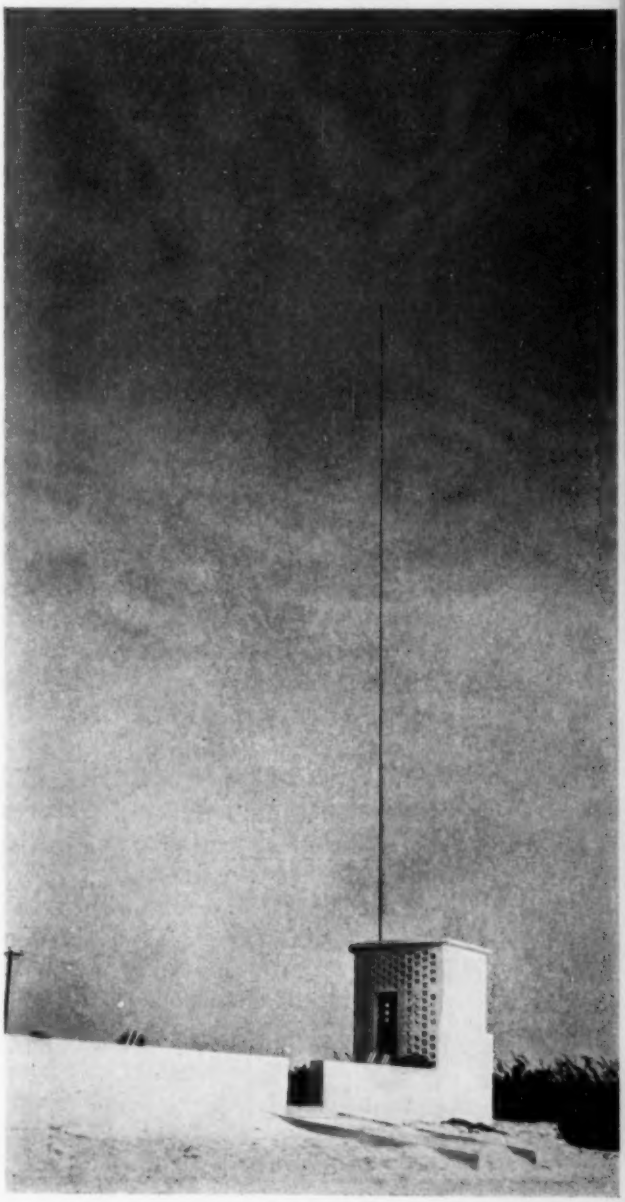


FIG. 3. *The radio telephone receiving station at Tampa, Fla., for coastal and harbor service*

FIG. 4. *This ship's radio telephone set, made by the Western Electric Company, provides conversation channels on four frequencies*

telephone stations of that customer on land, as for instance, between the dispatching office of the owner of a fleet of tow boats and such boats. The radio-link message charge for this service is lower than for general service, but the customer guarantees a certain amount of message revenue each month.

Growth of the Service

SHIP telephone service has shown a rapid rate of growth, as is shown in Figure 7. From 100 boats in 1936, the number of vessels equipped with radio telephones registered for Bell System service had grown to about 2,500 at the end of 1940, and there are now more than 3,000 boats equipped. Along with the marked increase in the number of boats equipped with telephones has come a very rapid increase in the number of radio telephone messages handled, as is also shown in Figure 7. In 1940, the number of these ship telephone messages handled through the Bell System shore stations was in excess of 50,000, or more than double the number handled in 1939.

When we speak of radio telephone service to ships, we can think of service to practically any kind of a boat that floats. The boats listed for telephone service include not only small fishing craft and pleasure craft, but also the largest commercial vessels. The illustrations on pages 240 and 241 show examples of some of the widely different types of boats which are equipped with radio telephones.

About 1700 yachts and pleasure craft are equipped with radio telephones. Being able to keep in touch with home and office by telephone has enabled many a yacht owner to enjoy extra days afloat. In case of a breakdown of any kind, aid can be summoned in short order and anxious hours avoided by those on shore. As a matter of fact, just the safety factor of being able to call for assistance has caused many a private boat owner to equip his yacht with a telephone.

The need for communication is present in all undertakings, and in the case of dredges, which are constantly at work on our harbors, canals, and rivers, the telephone is of constant aid in calling for an additional scow, or, when there is some breakage, in calling some nearby city so that the parts needed may be dispatched at once and little time lost in keeping the channel clear. The towing companies find that equipping their tug boats with radio telephones saves them much time in giving instructions as to picking up new tows. When a tow gets into difficulties, aid can be quickly summoned by telephone, and many a tow has been saved from loss by such a call for aid.

Another commercial use for the radio telephone has developed within the last year or so. In the constant search for petroleum, a new oil field has been located under the swamps and waters of southern Louisiana, and

FIG. 6.
This is the ship's telephone for use with the set shown below

a number of the large oil companies located in the area make frequent calls through the telephone company's shore station serving the Gulf coastal area.

Furnishing Weather Reports

IF a boat owner wants the latest weather report, he can get it from the telephone company, since twice a day the various shore stations send out weather reports on their regular shore-to-ship frequency. The weather reports are prepared especially by the United States Weather Bureau for the Coast Guard, with reports on wind and sea conditions. A typical report follows:

"This is the New York Marine Operator. Notice to all vessels. The following marine information was obtained from the United States Coast Guard at New York.

"United States Weather Bureau information—Forecast for southern New England and New Jersey coasts—Diminishing northwest winds this afternoon, clear this afternoon, increasing cloudiness Thursday.

"Sandy Hook observation 10:00 A.M. Eastern Standard Time—Barometer 30.12 inches falling, temperature 68 degrees, wind west 9 miles steady, sea slight, visibility 3 miles, weather clear with light haze."

The Coast Guard include with such weather information reports as to derelicts or other obstructions to navigation, and the whole report is sent by the Coast Guard to the telephone company by teletypewriter over wires furnished for this purpose. As a further service to the boat owners along our coast, when storm warnings are received such warnings are given out by the shore stations upon receipt and

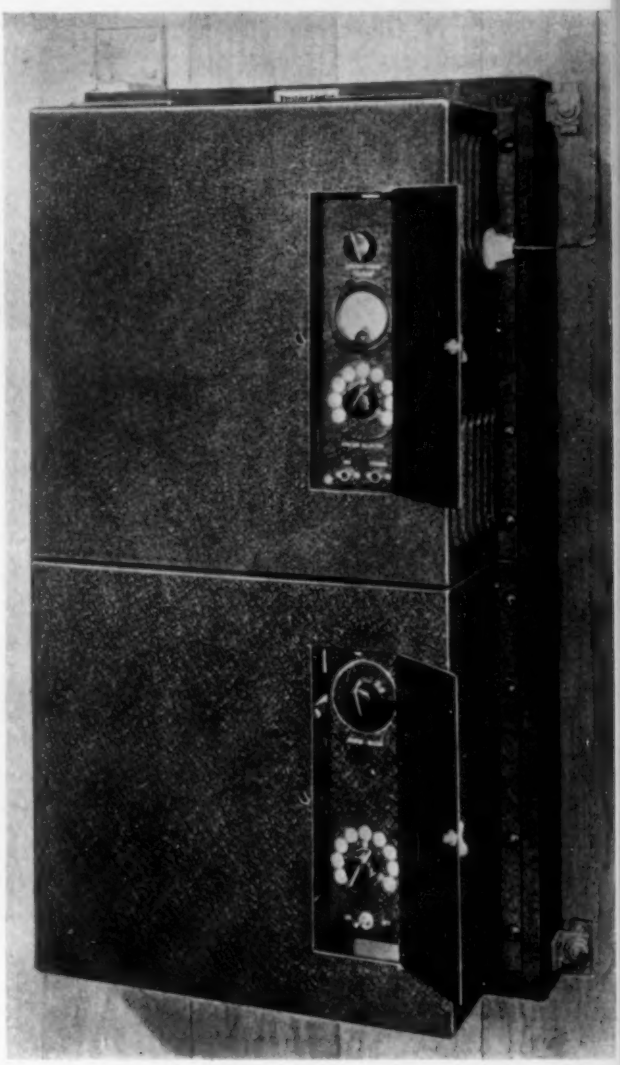
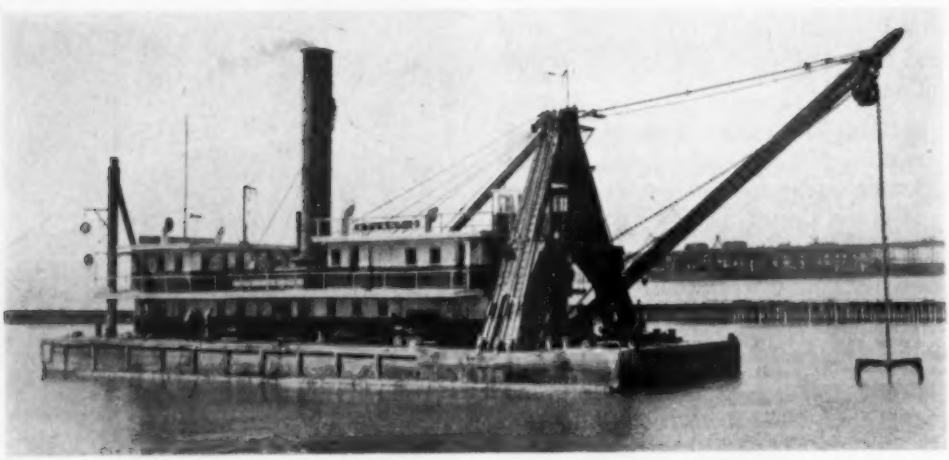
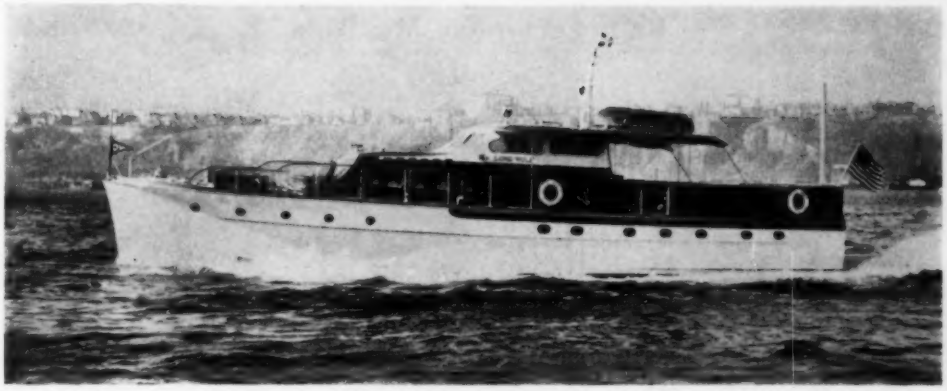


FIG. 5. *This larger Western Electric equipment has 100 watts' power, and provision for ten frequency channels*

Working Vessels

Ferry, tug, dredge—these are typical of the boats with jobs to do whose owners find radio telephone service an aid to efficient operation





PLEASURE CRAFT

Lone Wolf, *above, and* Wakiva, *below, are among the 1700 now radio-telephone equipped*

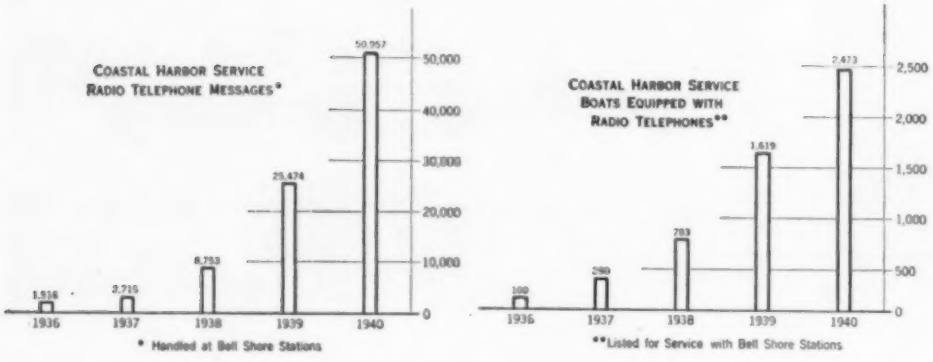


FIGURE 7

These charts illustrate the increase in use of the coastal and harbor radio telephone service

at two hour intervals up to the time of the next weather report. Furthermore, if a boat owner has failed to receive the regular weather report, he can call the nearest shore station and for a small charge the weather report will be given to him by the telephone company's operator.

Before a ship's radio telephone set can be operated, the owner of the vessel has to secure a ship radio station license from the Federal Communications Commission, and the owner or some one on the boat must have also a Restricted Radio Telephone Operator Permit—or higher grade radio telephone operator's license. To obtain a restricted permit requires only a knowledge of the principal laws and regulations relating to the operation of this type of radio equipment, and enough instruction to operate the radio equipment.

THE fifteen Bell System shore stations on our two coasts and the Gulf of Mexico give a coverage of practically our entire coast. Like the wire telephone plant, the radio plant is being constantly extended to meet the service needs of the public. However, it can now really be said that vessels along our coasts can talk at practically any time to any shore telephone just about as easily as we can talk to any of the 23,000,000 telephones in the United States. Thus, from the original aim of the telephone business of connecting all land telephones of the nation, the horizon for telephone service has been pushed out further and further, not only to reach all continents but also to serve those who travel by water as well as by land. Service to ships is simply another step in carrying out the aim of making telephone service available "anywhere."

PATENTS AND FREE ENTERPRISE

Comments on Monograph 31, Prepared for the Temporary National Economic Committee, and on the Relationship between the Patent System and Business and Industry in the United States

By WILLIAM R. BALLARD

One of the important subjects covered in the investigations of the Temporary National Economic Committee (often referred to as the Monopoly Investigation) was the use of patents in American industry. In addition to testimony at open hearings where views pro and con found expression, the Committee printed and distributed a large number of "Monographs" in the nature of ex parte *statements by various individuals. One of these, Monograph No. 31, is entitled "Patents and Free Enterprise." The following article discusses the same subject, using that Monograph to some extent as a text.*

MONOGRAPH 31 is not a reasoned discussion of the real relation between patents and free enterprise. Notwithstanding lip-service paid to the theory of patents, it is, in fact, merely a general attack on the patent system and upon the motives and practices of business.

Evidently the author has had little experience with either patents or practical business enterprise, and on its own merits the monograph does not deserve to be dignified by serious notice. Nevertheless the document, bearing as it does the name of the Temporary National Economic Committee and the stamp of the U. S. Government Printing Office, will doubtless be quoted as an authority by many who know no better or who are promoters of pet panaceas ready always to seize upon any "authority" that fits their theories. Under the circumstances, it seems in order to indicate the real character of the monograph by citing a few instances of its unreliability and then, by way of general answer, to give a brief statement of the real relation between patents and free enterprise.

I

ONE of the author's more fundamental errors is in treating a patent as an instrument for taking something away from the public and giving it to an individual. He says of the patent that it is ". . . a privilege, in the public domain . . ." (p. 158), "A private stake in a public domain . . ." (p. 51), ". . . staked out within the public domain" (p. 44), ". . . a private privilege in the public domain

. . ." (p. 151), etc. From this basic assumption the author moves on to expand his theory that the patentee's "privilege" should be sharply circumscribed (if not abolished) and that, as patentee, he has special "obligations to society" (p. 52). And he ridicules the courts for not disposing of all patent litigation (regardless of the actual issues involved) on the basis of the inquiry: Has or has not the patentee used his patent to promote public welfare?

The author's premise being entirely false, what he builds upon it is naturally worthless. A patent is *not* a private privilege carved out of the public domain. So far from being a means of taking something from the public and giving it to an individual, a patent is a means for getting something from an individual and giving it to the public. If a man makes an invention of the kind which can be protected by a patent, it is something which the public does not then have, and to which it has no claim. That invention belongs to the man who made it. He may, if he choose, keep it secret and practice it to his own profit. He may, if he choose, let the art die with him, as certain ancient arts actually did die. If anyone surreptitiously filches his secret invention, he has his remedy at law for the injury. The patent system is designed to induce him not only to do the inventing but to disclose his invention and give it to the public gratis after the term of the patent, in return for the assurance that he will be protected in the exclusive use of his own for those seventeen years, notwithstanding the disclosure. In this transaction, it is clear that only the inventor gives up anything of substance. To purchase the residuary rights in his invention the public contributes neither money nor anything else it possesses. It gives only a promise of temporary protection for the inventor's own intellectual property so that he may, if he can, make a profit for himself during the period of protection.

What, then, shall be said of one who undertakes to instruct the nation on "patents and free enterprise" and proceeds on the theory that a patent is a transfer of something from the public domain to an individual? Correct statements of the matter, which the author might easily have consulted, are abundant in the writings of authorities on the subject. As long ago as 1852 Daniel Webster stated it as plainly as this:

> ". . . The Constitution does not attempt to *give* an inventor a right to his invention, or to an author a right to his literary productions. No such thing. But the Constitution *recognizes* an original, pre-existing, inherent right of property in the invention, and authorizes Congress to secure to inventors the enjoyment of that right. But the right existed before the Constitution and above the Constitution, and is, as a natural right, more clear than that which a man can assert in almost any other kind of property. What a man earns by thought, study and care, is as much his own, as what he obtains by his hands. It is said that, by the natural law, the son has no right to inherit the estate of his father—or to take it by devise. But the natural law gives a man a right to his own acquisitions, as in the case of securing a quadruped, a bird, or a fish by his skill, industry, or perseverance. Invention, as a right of property, stands higher than inheritance or devise, because *it is personal earn-*

ing. It is more like acquisitions by the original right of nature. In all these there is an effort of mind as well as muscular strength.

"Upon acknowledged principles, rights acquired by invention stand on plainer principles of natural law than most other rights of property. Blackstone, and every other able writer on public law, thus regards this natural right and asserts man's title to his own invention or earnings.

"The right of an inventor to his invention is no monopoly. It is no monopoly in any other sense than as a man's own house is a monopoly. A monopoly, as it was understood in the ancient law, was a grant of the right to buy, sell, or carry on some particular trade, conferred on one of the king's subjects to the exclusion of all the rest. Such a monopoly is unjust. But a man's right to his own invention is a very different matter. It is no more a monopoly for him to possess that, than to possess his own homestead.

"But there is one remarkable difference in the two cases, which is this, that property in a man's own invention presents the only case where he is made to pay for the exclusive enjoyment of his own. For by law the permission so to enjoy the invention for a certain number of years is granted, on the condition that, at the expiration of the patent, the invention shall belong to the public. Not so with houses; not so with lands; nothing is paid for them, except the usual amount of taxation; but for the right to use his own, which the natural law gives him, the inventor as we have just seen, pays an enormous price. Yet there is a clamor out of doors, calculated to debauch the public mind." (Emphasis by Mr. Webster.*)

* "The Writings and Speeches of Daniel Webster," National Edition 1903, Vol. 15, pp. 438–439.

Even the following brief statement by Chief Justice Marshall (in a case cited by the author on another point) should have kept him from this basic blunder. Chief Justice Marshall said of the patent:

> "It is the reward stipulated for the advantages derived by the public for the exertions of the individual, and is intended as a stimulus to those exertions . . . The public yields nothing which it has not agreed to yield; it receives all which it has contracted to receive. The full benefit of the discovery, after its enjoyment by the discoverer for fourteen [now seventeen] years, is preserved; and for his exclusive enjoyment of it during that time the public faith is pledged." (6 Peters 217, 241–2.)

This underlying error alone indicates very clearly how little dependence can be placed upon statements in the monograph, but the whole article is honeycombed with lesser errors which show the same thing. A few will be noted.

II

In chapter VIII (p. 123 et seq.) the author discusses the procedure under which patents are granted, and asserts that it is such as to bias the Patent Office examiners in favor of the applicant and against the public in the granting and refusal of claims—that each officer passing upon the claims is prone to allow rather than to reject, lest he be reversed on appeal. Evidently the author has never been an examiner in the Patent Office, or had much to do with them. If he had, he would know that they take themselves quite seriously as custodians of the

public interest, and are eager to discover anticipating evidence. So zealous are they, indeed, that it is common for inventors and their attorneys to complain that the examiners constantly reject claims for meritorious inventions without adequate evidence of anticipation. Fear of reversal on appeal is not a factor. An examiner reversed on appeal may feel pity for the blundering tribunal that reversed him, but never fear or remorse. He is a specialist in a particular art, and regards himself as the one expert best qualified to make the correct decision.

III

ANOTHER error of fact is found on page 43, where the author, speaking of the use made of patent rights in the earlier history of the country, says:

> ". . . It was, however, even as late as 1890[13], unburdened by covenants which ran with the chattel or radiated along the channels of trade . . .

"[13] The Sherman Act was passed July 2, 1890."

It is important to the author's thesis to show that only in later years has the patent right been misused to the public detriment, one of the "misuses" particularly attacked being the granting of licenses for limited uses of the invention.

But this simply is not true. Patentees have granted licenses for limited uses, for limited amounts of manufacture, and for limited territories, etc., from the very beginning. The case of *Mitchell* v. *Hawley* (cited by the author himself in another connection) dealt with licenses granted about 1868 which were limited to making and using the invention

> ". . . in the said States of Massachusetts and New Hampshire, and in no other place or places . . ."

and forbade the licensee to

> ". . . in any way or form dispose of, sell or grant any license to use the said machines beyond the 3rd day of May, A.D. 1867"

and also with a sublicense

> ". . . to run and use two sets (four machines) . . . in said town of Haverhill . . ."

But strictly limited licenses were old even before that. Along in the 1840's, Goodyear held patents covering materials impregnated or coated with vulcanized rubber and he granted licenses limited in various ways, as for example *:

> ". . . for the manufacture of wearing apparel of every name and description for men and boys, excepting boots and shoes, bathing caps, gloves and mittens."

and again for:

> ". . . the manufacture of army and navy equipments . . ."

In a suit involving a limited license of this type the judge said:

> "For these reasons, I am of the opinion that the respondents, acting under that license, are restricted to the manufacture of cloths to be japanned, marbled, and variegated, as therein described, and that it confers no authority to manufacture any of the articles specified in the bill of complaint." †

* *Goodyear* v. *Providence, etc.*, 10 Fed. Cases 712.

† Idem, p. 723.

This decision was affirmed by the Supreme Court of the United States (9 Wallace 788), and in its decision that court noted that the license relied upon by defendants was one to an individual to be exercised "at his own establishment" only, and the court said this did not authorize manufacture in a place occupied jointly by that licensee and others.

IV

IN chapter VI (p. 87 et seq.), the author, speaking of the telephone industry, gives as facts (taken from the reports of the Federal Communications Commision investigation and "carefully checked") various delays by the Bell System (ranging from nine to thirty years) in the introduction of various named innovations assumed to have been needed and said to have been ready at hand all the time. And he reduces the allegation to tabular form at the top of page 93 to give it an air of exactness and finality. There is no truth in all of this, as those acquainted with the facts well know. Statements substantially the same as those made by this author are to be found in the reports of the F. C. C. investigators, but the comments on F. C. C. Exhibit No. 1989, filed by the American Telephone and Telegraph Company (pp. 64, 71, 94 to 122), and its brief on the proposed Walker reports (pp. 68 to 75), show that these statements were utterly unfounded. It would be interesting to know what means the author used for "carefully checking" these untruths.

V

AGAIN, the author misstates the fact in his discussion of the electric lamp patents and the Supreme Court's decision in *United States* v. *General Electric Company*, 272 U. S. 476. Despite the actual patent situation there involved, which the author seems to have known, he treats the licensing system in that case as a scheme to control the price of "the unpatented incandescent lamp" (footnote (*c*), p. 100). The fact, of course, is that the lamp in question was covered by three patents of basic character on important physical parts of the lamp itself. This makes all the difference in the world, because if the patents had been merely on a process of manufacture or a machine for manufacturing, the effort to control the price or the use of the unpatented product—the lamp—would plainly have been open to attack and subject to much of the criticism offered. The facts, if properly presented, would have undercut the author's high-sounding story.

Also, notwithstanding his own statement of the facts as to the agency contracts, he treats the arrangements there criticized as controlling the "resale" price of the lamp (footnote 31, p. 102 and footnote 25, p. 100). That is contrary to the fact. It was precisely because the control by the patentee was control only of the *original* sale price, and not of the resale price, that it was lawful rather than unlawful, and was upheld by the Supreme Court.

VI

ANOTHER and oft repeated error is in stating that patentees have a practice

of prolonging the life of their patents beyond the seventeen-year period. This is done, we are told, by taking out improvement patents. The text includes such expressions as "other inventions might be used to prolong their life" (p. 90); "so long as basic patents were periodically refreshed" (p. 110); "He may, by means of improvement, give to his grant a new lease of life" (p. 162).

The simple fact, of course, is that no patentee can prolong the life of his patent by so much as a single day. There can be no possible excuse for thus misstating the facts. It is a transparent attempt to mislead the reader into believing that patents are ready instruments of oppression and injustice.

When a patent has run its seventeen years, it ceases at once to be a bar to anyone in any way. The making, using, or selling of the thing covered by the patent is as free to one man as to another; and this is true whether improvement patents have been taken out or not.

And during the life of the patent one man as much as another is free to make and to patent improvements on the preceding invention. Of course, the man who makes the *best* improvement will, after the first patent expires, be in a better position to compete (so far as patents are concerned) than the man who makes a poor improvement, or none. If the same man who conducted a business under the first patent makes the best improvements he, of course, will have this competitive advantage; but this is the result of his effort and ability in making the improvements—not in any sense because of an extension of the monopoly of his old patent.

In this matter of making and patenting improvements there is a field of perfectly free competition. If the outsider, who wants to get in, has the ability and is willing to spend the time, money, and effort required to make and to patent the best improvements, he will hold the advantage in the business over the original patent owner when that patent expires. If he has not the ability or is not willing to make the effort, there is no reason why he should be permitted to take, free of cost, the improvements of someone else who has spent time, money, and effort in perfecting them.

If the author of Monograph 31 did not know and understand these simple and basic things about patents, he should have devoted some study to the subject before undertaking to instruct others.

VII

ANOTHER error repeatedly made is the assertion—either direct or implied—that the *assignment* of a patent diverts the patent right from its intended purpose and turns it to an unforeseen and undesirable end—often referred to as the "pursuit of gain" (see pp. 45, 46, 49, 133, 162 and elsewhere). Perhaps this is an error of conclusion rather than of fact, but a conclusion so obviously wrong that it is just as inexcusable. The author makes no effort to establish the point—he treats it as axiomatic, and upon it bases other wrong statements.

It seems almost too obvious to require stating that the very purpose of the patent law in granting an inventor

a patent is *to enable him to reap a profit* on the invention. The chance to do that is his reward for contributing to the advancement of science and the useful arts by making and disclosing the invention. From the point of view of the public, it is of no importance at all whether the patentee makes the profit by manufacturing and selling the invention himself, or makes it by selling his exclusive right to someone else. If he sells his patent to someone else, the purchaser, whether a corporation or an individual, gets no rights which the original patentee did not have. The author of the monograph, when off guard, admits this parity between the inventor and assignee. On page 103 he writes, "The inventor—or his assignee—is worthy of his reward." In the next sentence he suggests that this "reward" is only the right to collect royalty, but that, of course, is simply not true. The patent right, by definition, is the right to *exclude* others. The right to *permit* others, in consideration of payments, is merely an *incident* of the patent right.

Obviously *either* the inventor or his assignee *may* use the patent unlawfully, just as he may use any other private property unlawfully. For example, he may make an agreement or combination in restraint of trade which involves his patent, just as such an agreement may involve his grain or his horses. But the cure for this is not to decry the *sale* of the patent or the grain or the horses, but to prosecute the perpetrator of the *agreement* (whether inventor or assignee) under the anti-trust laws if he transgresses those laws.

VIII

ANOTHER error, also in the nature of a conclusion and which the author also treats as axiomatic, is the assumption that a patentee, as distinct from the owner of other property, is under some special obligation to society (see, for example, pp. 52, 53, 152 and 153). The author, having read Article I, Section 8, of the Constitution and found that the granting of the patent is intended "to promote the progress of science and useful arts," jumps to the conclusion that it is the *patentee* upon whom falls the duty of promoting the progress of science and the useful arts. Of course, this is plain foolishness. The Constitution expressly states that it is *Congress* that is to promote the progress of science and the useful arts. And the precise *way* Congress is to promote them is stated, namely, "by securing for limited times to . . . inventors the exclusive right to their . . . discoveries." So, it is *the fact that the exclusive rights are granted* which promotes the progress of science and the useful arts, and not something the inventor is expected to do *after* the grant is made. Once made, the grant, like any other piece of property, is something belonging entirely to the grantee. It is intended for *his* benefit and with it he may, as with his horse or his grain, do just as he pleases. The patentee's obligation to society is no greater, and of course no less, than the obligation of the holder of any other piece of personal property. The patent is something he has bought by yielding the price specified by the Government, and there the transaction ends.

Of course, anyone so blind as to be-

lieve that human beings have already attained such perfection that we can now thrive and progress without the stimulus of any private ownership at all will object to the private ownership of the patent right, and, since it seems easier to vilify this right as a "monopoly" than it is the corresponding monopoly in one's horse or his grain, it is natural that such a person should pick on patent property for propaganda purposes. But our author should realize that he has not in himself as yet the power to amend the Constitution. What he really tries to do is to rewrite the pertinent clause of the Constitution to make it read: Congress shall secure for limited times to inventors the exclusive right to their discoveries, and the inventors shall thereupon use the grant to promote the progress of science and the useful arts and not for their own profit.

Time and space will not permit discussion and correction of all of the erroneous statements contained in the monograph, and, if it were to be done, few would have the patience to read these comments through. If the document is read in the light of the foregoing, it will be clear that practically everything in it, aside from pure historical recitation, is misdirected or erroneous.

The Relation of Patents to Free Enterprise

THE author might perhaps have saved himself from some errors if he had thought of his subject as part of a more general case—as if the topic were "*Private Property* and Free Enterprise." Quite obviously, the right of any person in any private property does, to some extent, limit the freedom of others in conducting their business enterprises (and in other ways). If A owns a farm, B, of course, is not free to conduct an agricultural enterprise that would involve planting and cultivating A's acres. Just so, if A owns a patent on an invention, B is not free to conduct a manufacturing enterprise which would involve the making and selling of A's invention. And most certainly in neither case is there any reason why B should be "free" to do such a thing.

The American idea of free enterprise is not that a man should be free without permission to do business with the property of others, but that so long as he respects the property and other rights of his fellow men he shall be free to conduct whatever enterprise he will, wherever he will, and for such time and in such way as he may choose —and especially that he shall be free, so far as possible, from interference by the Government.

The basic relation between patents and free enterprise is so simple that it can be stated in one paragraph. It is precisely the same relation as between any other private property and free enterprise. While a man's, or a company's, ownership of private property is always in a true sense a monopoly of that property, and the control of it is often referred to as absolute, nevertheless it is also always true that the use of such property, whether it be patents, or grain, or horses, is subject to the general laws governing the use of property, as for example the anti-trust laws. And while, as already noted, private ownership of property is necessarily a limitation on the ac-

tivities of others, it is also true that private ownership and a complete control of the property involved not only promote free enterprise but are almost essential to it. No one can have a really free enterprise based upon a farm or a grocery store unless he has complete control of the farm or the store, and the same is true as to patents. The ownership of patents and the complete control they give of the invention covered are the cornerstones of hundreds of small enterprises in this country which are now free and thriving but which could not continue without the protection represented by the patents. If anyone doubts this, let him consult the testimony of the witnesses before the Congressional Committee in 1938 where a bill for compulsory licensing was being considered (O'Malley Committee hearing on H. R. 9259 et al., March, 1938).

To propose the destruction of useful property merely because it might be used as the subject of an agreement in restraint of trade, or otherwise in contravention of law, is childish. That, in substance, is what the author of Monograph 31 proposes as to patents. History indicates that oil is more likely to be used as the basis of combinations in restraint of trade than are alphabet blocks or tigers, but that is no reason for destroying or for denaturing the oil; and anyone who suggested that as the remedy would risk a trip to a clinic for mental observation.

Experience shows that patents, like oil, contribute to the public welfare. Let them remain as they are and continue their good work of promoting science and the useful arts. If owners of patents use them as the basis of agreements or combinations to get control of things which the patents themselves do not cover, the remedy is not to destroy the patent right but to enforce the anti-trust laws.

FOR THE RECORD

"THE BELL TELEPHONE SYSTEM"

A Book Review

"THE BELL TELEPHONE SYSTEM," by Arthur W. Page, vice president of the A. T. and T. Company in charge of the Information Department, is the first book of its kind. Not until now has there been a volume to which the average reader could turn for a concise account of the policies, organization, and performance of the Bell System in recent years, together with a reasoned estimate of what conditions are most likely to help or hinder the job of rendering telephone service in the future.

Mr. Page's method is first to show the System's character by stating the facts which reveal it. On the basis of this demonstrated character, he asks that the telephone companies be permitted to retain the freedom to go forward and do a constantly improving job. "Progress in the art, improvement in management and methods, preparedness for the future and liberty to act quickly and effectively and with undivided responsibility," he says, "are the positive factors from which the public may expect real benefits." Regulation by public authority is desirable and necessary so that management liberty to act will never be abused. But the taking over of management under the name of regulation is another matter. Under such circumstances, management initiative and responsibility will decline, and operating and service paralysis will be on the way.

It is impossible to read this book without obtaining a fresh realization that Bell System character is not just something to talk about, but is something real. "I am not talking about stage management—I am talking about character," Mr. Page remarks during his discussion of politeness and reasonableness as factors in good service. The reader will feel strongly that he is likewise talking about character when he discusses telephone rates, progress through research, wages and working conditions, and Bell System corporate relationships. In reviewing the reasonableness of telephone rates, he points out that had investors received one half of one per cent less on their investment in the years 1925–1940, the business would have incurred serious risk and danger while the saving to telephone users would have been less than two cents on the dollar. This saving to the consumer might well have meant the difference between good and inadequate service—or it might even have cost the consumer far more, ultimately, by jeopardizing the improved plant and methods from which future savings come. In short, only adequate earnings can give the System and the service the character they need.

The fundamental policy of the Bell System, as stated by Mr. Gifford at Dallas in 1927, is quoted at length. Mr. Page shows how the words of the policy have been sustained by deeds, and he forcibly suggests that this will continue if management is given the requisite freedom to act. If there has been doubt anywhere that the policy means what it says —to furnish the best possible telephone service at the least cost consistent with financial safety—this book ought to dispel

it. The reader can look forward to a heartening demonstration that the Bell System not only sets its sights high, but is intent on hitting the mark.

Although Mr. Page is concerned from start to finish with the moralities of his subject—with the principles and philosophy of the System—it would be wrong to imply that this makes for heavy reading. The author is a plain-speaking man with an extraordinary gift for getting directly to the point. His language is simple and his word-pictures often have a homely charm—as, for example, when speaking of the need for a balance of routine and initiative in telephone operations, he remarks that "The bull in the china shop was full of initiative." In discussing random suggestions for rate reductions, he points out that no rate reduction by itself can produce improvement or economy in telephone service; the vital thing is the improved technique that produces the saving that makes the reduction possible.

Such appraisals rest on faith in human nature, which Mr. Page has. His book is not for cynics. It is a book for people who will believe what it is reasonable to believe, who will think well of that which deserves to be held in esteem, who have faith that real progress can be made and who are willing to share the responsibility for making it.

"The Bell Telephone System" was published by Harper & Brothers on October 1.

NEW DEFENSE POST FOR W. H. HARRISON

William H. Harrison, who has been on leave of absence as vice president and chief engineer of the A. T. and T. Company since July, 1940, was appointed director of the production division of the Office of Production Management on August 29. This is the third important defense post in which Mr. Harrison has served since he went on leave of absence. At that time he was appointed director of construction in the production division of the National Defense Advisory Commission. When the OPM was organized in January, 1941, Mr. Harrison became chief of shipbuilding, construction, and supplies in the production division of the new organization. In his new post, Mr. Harrison directs all activities of the OPM production division, one of the six divisions through which the OPM now functions. The other five are civilian allocations, headed by Leon Henderson; labor, Sidney Hillman; materials, William L. Batt; priorities, Donald M. Nelson; and purchases, Douglas L. MacKeachie.

L. G. WOODFORD APPOINTED CHIEF ENGINEER

L. G. Woodford was appointed chief engineer of the A. T. and T. Company on September 10. Mr. Woodford has been assistant vice president of the company since July, 1940, and has been in charge of the Department of Operation and Engineering during Mr. W. H. Harrison's absence in Washington. Pending the latter's return, Mr. Woodford will continue to report to Vice President C. P. Cooper. Mr. Woodford began his telephone career in Des Moines in 1911. After experience in the commercial and plant engineering department of the Iowa Telephone Company, he was appointed appraisal engineer of the Northwestern Bell Telephone Company, with headquarters at Omaha, Nebraska, in 1915. From 1921 to 1923 he was engineer of costs and practices for the Northwestern Company. In the latter

year he joined the department of operation and engineering of the A. T. and T. Company at New York. Here he became plant inventory and costs engineer in 1927, plant extension engineer in 1933, operating results engineer in 1937, plant operation engineer in 1939, and in 1940 was appointed assistant vice president.

NEW RECORDS SET IN SEPTEMBER

SEPTEMBER of 1941 established new records for the number of telephones installed, the number of telephones in service, and the use of overseas radio telephone service.

There was a gain of about 142,400 telephones in service in the principal telephone subsidiaries of the American Telephone and Telegraph Company included in the Bell System during the month. This was the largest increase for any month in the history of the Bell System. The largest previous gain for a single month was 129,200, recorded in January, 1941. The net gain for nine months of this year totals 1,007,900, which is greater than the entire 1940 gain of 950,000, the largest increase for any year up to now.

The gain for August of this year was 110,400, and for September, 1940, was 109,200. The net gain for nine months in 1940 was 646,900. At the end of September this year there were about 18,489,300 telephones in the Bell System.

Overseas telephone traffic for the month of September soared to its highest level in the history of the service. The calls handled over the radio telephone facilities of the Bell System during the month showed an 85 per cent increase over September of 1940.

This level has been reached through the increase in transpacific and Pan American communications, despite the decline in European traffic because of war conditions. Telephone calls to important outposts of this country in Panama, Puerto Rico, and Hawaii also contributed to the record-breaking rise. Since the outbreak of war, traffic with Puerto Rico has doubled, with Hawaii has increased four-fold, and with Panama six-fold.

Overseas service is now available with 47 countries, of which 28 are reached by direct circuits. Although European traffic is only about 50 per cent of its pre-war volume, direct transatlantic circuits are maintained to London, Berne, Berlin, Rome, Madrid, and Lisbon.

To meet the unprecedented increases in overseas traffic the A. T. and T. Company has been speeding up measures to improve and augment the world network of radio telephone facilities radiating from the United States. During the last two years, additional facilities have been provided to Argentina, Brazil, Panama, Netherlands Indies, and the Philippines. Within the next few months, additional facilities also will be provided with Puerto Rico and Hawaii, as well as another circuit to Brazil.

INDEX TO VOLUME XX AVAILABLE

AN Index to Volume XX (1941) of the BELL TELEPHONE MAGAZINE may be obtained upon request to the Information Department of the American Telephone and Telegraph Company, 195 Broadway, New York, N. Y.

CONTRIBUTORS TO THIS ISSUE

AFTER four years as a field and laboratory entomologist with the U. S. Department of Agriculture while also attending Washington University for three years, HERVEY ROBERTS went into newspaper work in 1925 as a reporter on the St. Louis *Post-Dispatch*. In 1927 he became editor of *The Lumber Manufacturer and Dealer*, a lumber trade journal published in St. Louis, and *The Chicago Lumberman*, a Chicago affiliate, spending alternate two-week periods in those two cities. The following year he joined the Southwestern Bell Telephone Company as a copy writer in the Eastern Missouri-Arkansas area advertising department, and in 1929 was transferred to the company's general advertising department. He became advertising assistant in 1935, copy supervisor in 1938, and in 1939 was made editor of the company's employee magazine, *The Southwestern Telephone News*. In this capacity he has recently spent much time in the field covering defense activities in the Southwestern Bell territory such as his article describes. His interest in photography is an asset to his editorial duties, and some of the accompanying photographs are from his camera.

AFTER attending Washington University, St. Louis, Mo., HORACE H. NANCE joined the St. Louis staff of the Long Lines Department of the A. T. and T. Company in 1910 as an equipment attendant. In 1916 he went to Denver as district plant chief, and two years later was transferred to Washington, D. C. After absence in military service, he rejoined the Long Lines Department as a technical employee in New York. In 1919 he was appointed division superintendent of equipment construction at Chicago. A year later he was made division plant engineer in Atlanta, and in 1922 was transferred to Philadelphia in the same capacity. He was made Engineer of Transmission in New York in 1924, and in 1928 was appointed to the post of Plant Extension Engineer. For the next twelve years he was responsible for studies and plans for extending Long Lines plant facilities, and it was during this period that plans for the transcontinental cable matured. The preparation of much of the background data and the engineering studies touched on in the article of which he is the author came under his personal direction. In February of this year he was made Engineer of the Long Lines Department.

STARTING his Bell System career in 1903 in the accounting department of the New York Telephone Company, JAMES F. BEHAN transferred to the A. T. and T. Company in 1912 as an accountant, and in 1919 became Chief Accountant. A year later he was appointed Assistant Comptroller, and in 1933 was elected Treasurer. Always important in the work of the Treasury Department are the day-to-day contacts—by mail, by telephone, and in person—with that sizable section of the public which includes A. T. & T. security holders. During times of special activity, such as the recent convertible bond issue Mr. Behan describes, these contacts greatly multiply.

RETURNING to Harvard University in 1919 after serving with the American Red Cross during the World War, GAIUS W. MERWIN received his A.B. degree in 1920 as of the class of 1918. In November following his graduation he joined the

rate section of the Commercial Division of the American Telephone and Telegraph Company, and continued in rate work until 1925, when he transferred to the operation results section. After a year and a half, he returned to the rate section as a group head, first on toll rates and later on exchange rates. In 1929 he attended the Public Utility Course at the summer session of the Graduate School of Business Administration of Harvard University. He was made Staff Engineer in Administration–M Department in 1936, where he handles patent licensing activities and keeps in touch with new services —such as the ship telephone service he describes. He contributed "The Telephone Goes Down to the Sea in Ships" to the July, 1938, issue of the BELL TELEPHONE QUARTERLY.

EXPERIENCE with patent matters began for WILLIAM R. BALLARD with his appointment as assistant examiner in the United States Patent Office in 1904. He served at different times in divisions of that Office concerned with applications for patents relating to tools, electrical apparatus, and textiles. During the later years there he was Solicitor for the Patent Office, representing it in numerous cases before the courts, and for a time was a Special Assistant to the United States District Attorney for the Southern District of New York in connection with litigation there relating to patent matters. He holds the degree of LL.B. from George Washington University. He was admitted to the Bar of the United States Supreme Court in 1911, and is also a member of the New York State Bar and the Bars of several of the federal district courts of the country. He joined the A. T. and T. Company in 1917 as patent attorney, and has taken an active part in most of the patent litigation involving the company since that time. In 1937 Mr. Ballard was made General Patent Attorney for the American Telephone and Telegraph Company, the position he now holds.